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February 13, 2014

State of Utah – Department of Environmental Quality
Division of Water Quality
288 North 1466 West
P.O. Box 144870
Salt Lake City, Utah 84111-4870

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Utah Division of Water Quality
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Attention: Mr. Woodrow W. Campbell, P.E.

Subject: CS Mining, LLC
ITDF East Starter Dam Permit Application
West of Milford, Utah

Mr. Campbell,

The attached design plans and construction specifications are submitted for your review and approval addressing the development of a lined Intermediate Tailings Disposal Facility (ITDF) located approximately one-half mile east of the existing tailings facility at the CS Mine near Milford, Utah. At this time we are only submitting the permit application for the eastern segment of the ITDF. A permit modification will be submitted later this year for development of the adjoining drainage to the west of this facility, the west ITDF starter dam along with their eventual merger into a singular facility with subsequent upstream lined raises.

As the drawings show, we are proposing the use of 40-mil HDPE material similar to the existing permitted tailings facility. This phased facility development is shown in the accompanying drawing package and discussed in the attached report to allow an orderly and sequential development of the overall ITDF. A separate but identical package is being submitted to Mr. David Marble, P.E. at the Division of Water Rights as a permit application to construct the starter dam required for the facility.

Should you have any questions, please do not hesitate to call me at (801)-270-9400 or my cell (801)-243-9603.

Respectfully submitted,
IGES, Inc.

PROFESSIONAL ENGINEER
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Document Date 2/14/2014
DWQ-2014-002811

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Intermediate Tailings Disposal Facility (ITDF) East Starter Dam Technical Report and Permit Application

IGES Job No. 01640-002

February 13, 2014

Prepared for:

CS Mining
P.O. Box 608
Milford, Utah 84751

TABLE OF CONTENTS

APPENDICES

1.0 EXECUTIVE SUMMARY

The site owned and operated by CS Mining is located approximately 8 miles northwest of Milford, in Beaver County Utah. Additional long term tailings storage capacity will be required to continue operations. The expansion will consist of phased construction of a new tailings impoundment located approximately 1/2 mile southeast of the beneficiation facility. The areas proposed for development are located in two small drainages east of the existing plant site. Proposed development will consist of two impoundments (West and East) collectively known as the Intermediate Tailings Disposal Facility (ITDF) constructed with starter dams and subsequently raised using upstream construction methods. This permit application will focus only on the east starter dam and discuss future development of the ITDF with the second starter dam and subsequent raises for informational purposes.

Construction of the ITDF is to be broken up into four distinct phases. Starter dams will have 3 horizontal:1 vertical (3H: 1V) upstream/interior slopes and 2H:1V downstream/exterior slopes and will be fully lined with a smooth 40 mil high density polyethylene (HDPE) liner. Subsequent upstream raises will have 1.5H: 1V upstream slopes and 2.5H: 1V downstream slopes and are designed to be lined with a geocomposite liner (GCL). The GCL will also line the raised sideslopes of the impoundments and transition to a HDPE liner in the areas projected to contain supernatant (free waters) prior to recovery and recycle to the mill. For upstream raises, a geofabric will be placed atop the tailings beach to facilitate initial raise fill placement functioning to both separate and minimize tailings displacement during initial fill placement.

All the embankments associated with the proposed impoundment will consists of locally derived soils and have a 20 ft. wide crest for vehicle access. Source of borrow soils to be used for the proposed starter dams and subsequent expansion will be developed within the proposed impoundment basin and immediately north and slightly west of the existing facility. All borrow materials will be composed of residual, highly weathered and decomposed granodiorite that underlie the ITDF sites and the adjacent areas. Portions of the borrow material will be developed from a ridge area that separates the two drainages.

Clarified supernatant will collect in the pond before recycle and reuse in plant processes. Impounded clarified waters will be recovered and pumped back to the beneficiation facilities using the same or similar floating barge and piping system currently being employed at the existing tailings operations.

The purpose of this report and Permit Application is to demonstrate the technical feasibility of the proposed impoundment facilities and present detailed engineering plans supporting the proposed design approach.

NOTICE: The scope of services provided within this report are limited to the assessment of the subsurface conditions at the subject site. The executive summary is provided solely for purposes of overview and is not intended to replace the report of which it is part and should not be used separately from the report.

2.0 INTRODUCTION

2.1 PURPOSE AND SCOPE OF WORK

This report presents the results of a geotechnical investigation and analyses conducted for the proposed expansion of CS Mining's tailings management operations through the development of a new facility designated as the Intermediate Tailings Disposal Facility (ITDF). A site investigation of site stratigraphy and geotechnical characterization of the proposed borrow materials was performed as a basis for development of the proposed design. Analysis of existing tailings beach materials from the flotation tailings pond was performed by IGES as presented in their report dated June 13, 2013, relevant portions of which are included as an appendix to this submittal. This expansion design will serve as the basis for the application for a new Ground Water Discharge Permit and associated construction permit to be administered by The Utah State Department of Environmental Quality, and an application for a Dam Safety Permit to be issued by the Utah State Engineer, Division of Water Rights. The recommendations contained in this report are subject to the limitations presented in the "Limitations" section of this report.

2.2 PROJECT DESCRIPTION

The ITDF will be developed sequentially by construction of the east starter dam followed by the west starter dam as tailings are initially placed to the east, then west of a natural ridge which separates two basins. Tailings will be placed in the east basin during construction of the west basin. A series of 10 ft raises will be constructed atop each of the starter dams as the basins fill with tailings. After tailings fill reaches an elevation of 5815 ft, the two separate basins will function as a single larger basin. The combined facility will ultimately occupy approximately 72 acres in total and have the capacity to contain 6.7 million tons of mill tailings. Tailings will be deposited into the impound using a managed discharge approach in order to build a tailings beach along the upstream dam faces to allow expansion using upstream methods with four subsequent 10 ft. raises. This approach to managed deposition will cause the clarified supernatant pool to be developed in the northern reaches of the basin(s) where clarified waters will be recycled to the mill using a floating barge pumping system similar to that currently employed at the existing tailings operations.

The proposed ITDF development will be sequential, initiating with development of the east drainage starter dam and basin lining. The east starter dam will be constructed to a crest elevation of El. 5820' and have a minimum crest width of 20 feet. Downstream slopes will be 2H:1V with upstream slopes constructed at 3H:1V to facilitate lining. The basin liner will be fusion welded smooth 40 mil high density polyethelene (HDPE). Side slope of the basin will be graded to 3H:1V or flatter in order to develop borrow for starter dam construction and facilitate liner deployment and installation. The exposed decomposed granodiorite will be graded and compacted to form a suitable base for liner installment.

Portions of a ridge that currently separates the east and west drainages that form the ITDF will be excavated as an additional source of borrow material for the east starter dam. The entire east basin will be grubbed to remove existing vegetation. The thin veneer of topsoil and underlying residuum approximately 12 inches in thickness will be removed and stockpiled for future reclamation activities. The foundation within the dam footprint will be overexcavated to between 5 and 12 feet, extending to the underlying weathered bedrock, placed and recompacted to form a structural foundation for the starter dam.

A perimeter road will be cut at the perimeter of the impoundment to facilitate liner installation and anchor trench development as well as future line expansion and early tailings facility access. Ultimately an access road will extend around the facility for maintenance purposes, pipeline management and subsequent raise development. The road around the north perimeter of the ITDF will facilitate installation and maintenance of the required tailings distribution and recycle water pipeline. The upslope edge of the road will form a channel to divert and manage upland surface water runoff from the approximate 84 acre watershed. Incident precipitation will be contained within the ITDF.

Perimeter discharge of the tails would commence from the starter dam crests to facilitate upstream raises, thereby creating a clarified pool to the north while allowing tailings adjacent to the embankments to dry out. Key physical parameters for the initial phases of the proposed ITDF construction are summarized in the following table.

Parameter	Units	East Dam	West Dam	Combined ITDF
Maximum Starter Dam Height	Feet (elev)	111 (5820')	48 (5830')	
Starter Dam Fill Requirement	c.y.	415,000	151,000	566,000
Initial capacity	c.y.	1,181,600	465,600	1,584,200
Initial Basin Area	acres	29.8	17.2	47
Upslope Diverted Drainage Area	acres	11.2	72.7	83.9

3.0 METHODS OF STUDY

3.1 GEOLOGIC INVESTIGATION

The geologic conditions for the general area have previously been investigated and discussed by R. J. Bayer, P.G.[1] (2014) in the GWDPA and are included herein by reference.

3.2 SUBSURFACE INVESTIGATION

Geotechnical conditions were explored throughout the site, locations are shown on the Exploration Location Map on Plates A-2a and A-2b. Three borings were advanced by IGES, Inc. to obtain rock cores of Granodiorite and evaluate competency of near surface bedrock. IGES borings were advanced from 35 to 50 feet below ground surface (bgs). One additional boring was advanced by CS Mining to evaluate deeper rock characteristics to 200 feet bgs. 36 Test Pits were excavated with a backhoe. Geophysical surveys were conducted to evaluate continuity of surficial soils and quality of bedrock based on Shear Wave Velocity. One study was conducted atop the ridge that separates the east and west basins to investigate the feasibility to excavate these materials as a borrow source for dam construction. Results of the survey indicate that suitable borrow may be developed in the ridge area to a depth of 20-30 feet or more without the need to blast. A second shear velocity profile survey was conducted beneath and downstream of the east starter dam footprint to confirm foundation competency.

Site soils are generally Well to Poorly Graded SAND with silt or Silty SAND in the upper 8 to 10 feet. The surficial soils are underlain by a highly weathered Granodiorite grading to competent bedrock at approximately 30 feet.

IGES Inc. conducted the subsurface investigations of potential borrow sources on March 7, 2013, March 26, 2013, and August 7, 2013. Exploration of the subsurface soil was accomplished by excavating test pits in potential borrow areas. Test pits were excavated by CS Mining staff under the direct supervision of IGES with test pits being logges by IGES and samples being taken for future laboratory evaluation. All test pits were backfilled using excavated materials at the conclusion of logging and sampling. Bedrock conditions were investigated by IGES by advancing borings B-1 through B-3, from which rock cores were obtained, on August 13, 2013.

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[1] Ground Water Discharge Permit Application for CS Mining, LLC, Solution Ponds and Intermediate Tailings Disposal Project, January 30, 2014 prepared by R. J. Bayer Professional Geologist, LC..

Geophysical surveys were conducted on August 20 and December 3, 2013. Surveys confirmed that site soils extended to approximately 8 to 10 feet below ground surface, underlain by highly weathered bedrock grading to competent bedrock at approximately 30 feet below site grade. The approximate locations of the explorations completed are shown on the Exploration Location Map (Plates A-2a and A-2b). The materials encountered during our investigations are presented on the Boring Logs, Plates B-1 through 4 and on the Test Pit Logs, Plates B-5 through 40. The key to USCS Soil Symbols and Terms and the Key to Rock Properties are located on Plate B- 41 and 42. Geophysical Survey results are presented in Appendix B.

Bulk samples were obtained from the materials encountered in the test pits. Bulk bucket samples of potential borrow materials were collected in 5 gallon buckets and sealed with air tight lids for preservation. All investigation activities and sampling were performed under the direction and supervision of an experienced IGES geotechnical engineer, with the exception of the ITDF boring performed by CS Mining.

3.3 LABORATORY INVESTIGATION

In order to assess the stability of proposed embankments, site stratigraphy and strength properties of borrow materials were determined. Representative soil samples were tested in the laboratory to evaluate pertinent physical and engineering properties. Laboratory soil tests consisted of moisture, gradation analyses, Atterberg limits tests, laboratory compaction, triaxial compression, direct shear, pinhole dispersion and hydraulic conductivity tests to aid in characterizing the soils and to develop design parameters for our stability and seepage analyses and for correlation purposes. Strength tests were performed on recompacted bulk samples of proposed borrow materials. The results of the laboratory tests are presented in Appendix C.

Bulk bag and bucket samples were taken from the test pits. Samples were preserved in the field and returned to the laboratory for confirmatory classification and laboratory testing. Moisture density relationships were developed according to the standard Proctor method (ASTM D698B). Bulk samples were remolded to simulate constructed site conditions for use in strength, permeability, and dispersion testing. A series of strength tests were performed on recompacted and remolded bulk samples of potential borrow fill. Consolidated Undrained with pore pressure measurements (CUPP) triaxial tests were performed to determine total stress and effective stress strength parameters. Direct shear tests were performed to determine the effective friction angle (ϕ') and cohesion intercept (c') of selected samples.

4.0 GEOLOGIC CONDITIONS

4.1 GEOLOGIC SETTING

The site is located immediately south of the Beaver Lake Mountains within the Warm Springs-Pioche-Marysville Mineralization Belt (Rowley, et al, 1979). Surficial soils are primarily composed of decomposed Granodiorite, overlying highly weathered grading to competent Granodiorite. The project area can be described as having 2 to 12 feet of alluvium overlying diotitic bedrock. Some faulting exists in the area, but no evidence of faulting in the area is reported in the literature or by CSM geologists.

Location of the site is at Latitude N 38E 28' 51", Longitude W 113E 07'03"

There is no surface water, with the exception of that contained within the existing tailings impoundment, in the general area. Other than minor groundwater in fractures, groundwater is reported to be at depths greater than 100 feet.

4.2 SEISMICITY

The spectral accelerations mapped as a part of NEHRP/NSHMP generally correspond to a "firm rock" site, known as Site Class B. To account for site effects, the PGA is typically modified using a site coefficient that varies with the magnitude of spectral acceleration, distance to seismic source, and the harmonic mean of the shear wave velocity of earth materials in the upper 30 meters, V_s^{30}.

Based on available laboratory data and estimated shear wave velocities the soils underlying the site are classified as Site Class C ("very dense soil and soft rock").

The 2PE50 accelerations were calculated with the aid of the USGS Seismic Hazard Curves and Uniform Hazard Response Spectra v. 5.1.0 application. Data from the probabilistic hazard curve for the 2% probability of exceedance in 50 years was used to calculate the acceleration for evaluating seismic stability of the proposed impoundment expansion. The 2PE50 ground motion for the site, corrected for site class, has been established as 0.26 g. Details of this analysis are included in the Appendix on Plate E-1.

4.4 OTHER GEOLOGIC HAZARDS

Geologic hazards can be defined as naturally occurring geologic conditions or processes that could present a danger to human life and property. The only potential geologic hazard relevant to the proposed facility modification is liquefaction. This potential hazard is addressed in the following section.

4.4.1 Liquefaction

The nature of the gradation for the hydraulically placed tailings makes them susceptible to liquefaction under design seismic conditions. The limited performance life required of the proposed expansion; i.e. 4 to 8 years, eventual drainage of the tailings and reclamation of the site makes the potential impacts of liquefaction of the tailings supporting the proposed raise of the impoundment of minimal concern. Liquefaction of the impounded tailings will have no effect on the lined starter dam embankment structures.

5.0 GENERALIZED SITE CONDITIONS

5.1 SURFACE CONDITIONS

The surface of the site is generally sandy with occasional rocky outcrops. The site is well-drained with poor vegetation cover. The Milford Utah area is typically warm and dry in the summer and cold and dry in the winter, as indicated by precipitation records and by the sparse vegetation on site. The 100 year storm over a 24 hour period will consider the peak maximum precipitation for the site at 2.99 inches.

The site slopes towards the center of the proposed east tailings dike at a 10 to 35% grade, then trends toward the southeast. An intermittent drainage is located in the center of the proposed tailings impoundment. The ephemeral drainage channel is down the center of the proposed tailings impoundment and is the outfall for the watershed in which the tailings impoundment is located. Surface water runoff that may develop from the watershed upslope of the ITDF will be diverted by a shallow V-shaped ditch that will run along the upstream edge of the access road/pipeline corridor between the mill and the ITDF.

5.2 SUBSURFACE CONDITIONS

5.2.1 Soils

Subsurface conditions beneath the site are described and discussed in GEM[2] (2009).

Test pits excavated to characterize the potential borrow area proposed for embankment raise construction encountered approximately 6 inches of sandy silt with a thin root mat that can be characterized as "topsoil". This veneer of "topsoil" was typically underlain by a medium dense, poorly graded silty sand classifying as an SM to SP-SM, based on the Unified Soil Classification System (USCS). These near surface sands contained some gravel and cobble sized rock fragments of weathered rock and transitioned to the underlying bedrock (granodiorite) generally at depths ranging between 6 and 7 feet.

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[2] Mill Tailings Impound Basin, Technical Report and Permit Application, prepared for Western Utah Copper, Report Number RE0106 by GEM Engineering, Inc. dated September 2, 2009.

5.2.2 Bedrock

Depth to bedrock varies across the site ranging from 2 to 15 feet below ground surface. Similar conditions were found within the proposed borrow area within the impoundment. Weathered bedrock was composed of a Granodiorite overlain by a completely decomposed mantel of this parent rock characterized as a sand with gravel (SP-SM). A thin veneer of sandy silt with gravel covers these residual soils and weathered bedrock.

5.2.3 Groundwater

Depth to groundwater at the site was previously reported by GEM[3] (2009) to between 100 to 250 feet below the base of the impoundment.

Groundwater was not encountered in any of the explorations performed by IGES, Inc. CS Mining also performed a boring to 200 feet at the tailings dam site and groundwater was not encountered. The starter dike and base of the pond is designed to be fully lined to minimize infiltration of tailings impoundment water into the basin subsurface.

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[3] Mill Tailings Impound Basin, Technical Report and Permit Application, prepared for Western Utah Copper, Report Number RE0106 by GEM Engineering, Inc. dated September 2, 2009.

6.0 ENGINEERING ANALYSIS AND DESIGN RECOMMENDATIONS

6.1 GENERAL CONCLUSIONS

Supporting data upon which the following recommendations are based have been presented in the previous sections of this report and laboratory data. The recommendations presented herein are governed by the physical properties of the soils encountered in the exploratory test pits, borings, and surveys, and the anticipated construction. If subsurface conditions other than those described herein are encountered in conjunction with construction, and/or if design and layout changes are initiated, IGES must be informed so that our recommendations can be reviewed and revised as changes or conditions may require.

Based on the subsurface conditions encountered at the site, our literature review of geologic hazards and our engineering analysis, it is our opinion that the proposed construction can be completed provided the designs and recommendations contained within the following sections and attached drawings are properly implemented during construction. We recommend that IGES, Inc. be involved during the construction to see that the recommendations contained in this report are complied with.

6.2 EARTHWORK

General site grading will be required for the proposed expansion. The primary concerns during the earthwork for the project are that perforation of the HPDE liner material is prevented, a firm foundation for starter dike is established, and the amount of fill displacement during upstream raise construction is minimized. The uppermost 12 inches of soil and residuum within the proposed basin, dam, and borrow area designated as topsoil should be stripped and stockpiled for use in future reclamation activities.

6.2.1 General Site Preparation and Grading

The tailings impoundment basin must be grubbed of all vegetation. Grading should be performed to eliminate all protrusions that may perforate HDPE liner material. Sharp rock or other deleterious materials exposed at the graded surface that could cause such perforations should not be allowed to contact with liner material. Perform basin grading and liner placement in conformance to manufacturer recommendations.

Areas beneath the proposed starter dikes should be grubbed of topsoil and all vegetation. Before placement of starter dike structural fill, the subgrade should be prepared to provide a firm foundation. The subgrade should be benched to provide a horizontal plane for compaction, scarified to 8 inches, moisture conditioned, and compacted. Subgrade should be compacted to at least 95 percent of the maximum dry density, as determined by Standard Proctor (ASTM D-698). The moisture content should be within +/- 2 percent of optimum water content at the time of compaction as determined by ASTM D-698.

Site preparation for future raises on the tailings beach will be limited because of the relative softness of the wet materials. Prior to placement of an initial 12 to 18 inch layer of fill soils on the beach, use of a geofabric as a separation and stabilization material will be required. Installation of a 270 lb/in (ultimate strength ASTM D-4595 basis) woven slit film geofabric such as Comtrac P45.45 by Huesker, Inc. or equal will be required to facilitate initial fill material placement spanning the entire width of the raise fill. The fabric will be extended up the upstream face of the existing embankment and suitably anchored at the crest. Required panel width of geofabric will require field sewing to attach adjoining fabric panels beneath the entire raise fill width. Initial fill placement will require the use of low ground pressure tracked equipment and not be suitable for direct fill placement until an initial 4 ft. layer has been developed.

6.2.2 Structural Fill and Compaction

Fill placed in conjunction with development of the tailings impoundment will consist of compacted structural fill from designated borrow sites. Structural fill should be placed in maximum 8- inch loose lifts and compacted on a horizontal plane, unless otherwise approved by the Geotechnical Engineer. Structural fill should be compacted to at least 95 percent of maximum dry density at ±2 percent of optimum water content at the time of placement as determined by ASTM D-698. Borrow materials should be approved prior to importing.

For upstream raises the initial 12 to 18 inches of fill should be comprised of approved borrow material placed on geofabric. However, based on IGES experience with similar projects, borrow material cannot be compacted to the specified requirements of structural fill due to the limited stability of the underlying tailings. These materials will only be subject to compaction via trafficking of the placement and spreading equipment. A minimum of three passes will be required. Also, prior to placing fill, the placement of the geofabric including seaming (sewing) and anchorage should be observed by IGES, Inc. to confirm that materials have been properly placed, sewn and anchored.

6.3 SURFACE WATER HYDROLOGY

On site there are no perennial streams or surface water. The Sevier Lake Playa and the Beaver River are the nearest bodies of surficial water. The probable maximum precipitation (PMP) estimate for the site is relatively low, with an upper bound value of 2.99 inches for a 100 year 24 hour storm.

Surficial soils are generally poorly graded SAND to Silty SAND composed of decomposed Granodiorite bedrock. Surficial soils extend to highly weathered bedrock at 2 to 15 feet below ground surface. Competent bedrock was encountered in the on-site explorations and geophysical surveys at approximately 30 feet below ground surface. In situ site soils and highly weathered bedrock are assumed to be sandy and well-drained.

The site may be considered an arid or semiarid region of the Great Basin Drainage. Observations of surface conditions support an estimate of less than 30 percent desert shrub vegetation on-site.

Site topography is somewhat mountainous with grades approaching 35%. The tailings pond is located at a location and grade such that there is 101 acres upslope watershed running onto the final design tailings pond of approximately 60 acres. Utilizing the Urban Hydrology for Small Watersheds Technical Release (TR-55) method it is estimated that the upslope watershed could potentially contribute approximately 0.42 inches per acre of runoff of the 2.99 inches per acre considered in the design. Assuming the PMP of 2.99 inches is retained in the tailings pond, the run-on from the upstream watershed could potentially contribute 0.75 additional inches of water to the ITDF. Details of the TR-55 analysis are presented in the Appendix on Plates D-1 through 6.

In order to intercept run-on water a ditch is proposed to convey stormwaters around the pond perimeter. An access road will be constructed around the perimeter of the pond with the ditch on the upstream side of the road. If the road is constructed such that it crests on the saddle on north side of the pond at 5900' and daylights on the east and west side of the proposed dike at elevation 5860', the watershed affecting the pond will be reduced to approximately 84 acres. The 84 acres of runoff should be intercepted by the ditch with channel side slopes of 4H:1V, a bottom width of 1 foot, and a minimum depth of 1.5 feet. The design storm should generate a potential maximum discharge of 21 cubic feet per second with armored outfalls on the east and west end of the dikes to permit drainage discharge on the native surface of the existing hillsides. The proposed alignments of the ditches are shown on Sheet D-8.

6.4 ANALYSES OF DIKE GEOMETRIES

6.4.1 Interpretation

Slope Stability analyses were performed on the east and west dike geometries under various loading conditions. IGES, Inc. performed the analyses assuming the dikes are to be constructed primarily from on-site soils. Appropriate borrow soils were identified in all test pits performed by IGES. The basin of the tailings pond impoundment will be stripped of suitable dike construction materials before impoundment in each area begins.

Both the eastern and western dikes will consist of two phases, a starter dike to 5820' and a series of 10 feet upstream raises to 5860'. Typical starter dike construction is designed to have dike raises on the downstream side and 2H: 1V downstream slopes and 3H: 1V upstream slopes to 5820'. Upstream raises will be constructed with 2.5H: 1V downstream slopes and 1.5H: 1V upstream slopes. The basin and starter dike will be lined with 40 mil smooth HDPE, and GCL is planned to line the upstream side of upstream raises.

Based on our experience at the CS Mining site and at a number of other similar impoundments, it is our professional opinion that upstream construction methods can safely and economically be employed to construct the 10 feet raises proposed on the starter dike embankments. The use of moderate strength geofabric is recommended to limit beach material displacement.

6.4.2 Seepage Analyses

For the purposes of stability modeling, the groundwater surface used in the analyses was based on the finite element program SEEP 2D within the SLIDE software using estimated coefficients of permeability for both the tailings and dike soils. The following summarizes the general stratigraphy and material properties assigned for the analyses of the proposed starter dike and upstream raises. The seepage surface is calculated based on the assumption that conditions are in a steady state. Values for the coefficient of permeability shown below were adapted from permeability tests on laboratory compacted samples and engineering judgment. Values assigned to the model used to calculate the seepage surface are presented in the following.

Upstream beach – normally consolidated tailings– SM/ML
Coefficient of permeability – k – 1.0×10^{-4} in/s

Silty Sand – overlying residual soils
Coefficient of permeability – k – 1.2×10^{-4} in/s

Dike Fill – borrowed site soil
Coefficient of permeability – k – 1.2×10^{-5} in/s

For long term analyses on the proposed starter dikes, the water surface in the pond was assumed to be 2 feet below the top of the starter dike at 5820'. An additional long term model of stability and seepage was also modeled with the phreatic surface at 2 feet below the proposed dike elevation at the maximum design storage level for the raise at 5860'. This level was used to model the slope stability and seepage analysis for the End of Construction (EOC) period of the construction sequences. The phreatic surface is shown in the slope stability models as a blue line that lies on the tailings surface and is confined by the proposed liner.

Seepage losses from within the basin are estimated to be de minimus since the entire initial phase of the basin will be lined with 40-mil HDPE.

6.4.3 Stability Analyses

Laboratory data was reviewed to select representative material properties for modeling the dike sections selected for stability analyses. Foundation stratigraphy was depicted using the results obtained from the soil logs. Soil properties for the dikes, tailings, and native material were generalized from laboratory testing conducted and summarized in Appendix E. The following summarizes the general stratigraphy and material properties assigned for the analyses of the starter dam and raises.

Tailings – normally consolidated

Total unit weight – 128 pcf

Effective ϕ' – 30 degrees

Total ϕ – 27 degrees

Effective and Total cohesion – 0 psf

Dike Fill – Borrow

Total unit weight – 130 pcf

Effective ϕ' – 37 degrees

Total ϕ – 14 degrees

Effective cohesion – 100 psf

Total cohesion – 1600 psf

Native Soils

Total unit weight – 123 pcf

Effective ϕ – 35 degrees

Effective cohesion – 100 psf

Bedrock

Total unit weight – 140 to 150 pcf

Effective ϕ – 35 degrees

Effective cohesion – 800 to 2000 psf

Analyses

Slope stability analyses were performed using the software program SLIDE 6.025 from RocScience. Strength parameters were developed for the generalized stratigraphic profile based on the investigation and testing performed. In order to determine tailings and dike fill strength properties, direct shear and triaxial tests of remolded samples from test pits were used to determine the mean friction angle.

Two cross-sections were analyzed, cross-section A-A' of the eastern dike at its highest and cross-section B-B' of the western dike at its highest. The cross-sections were selected to represent the most critical dike geometries.

Pseudo-dynamic analyses were performed to evaluate stability under earthquake conditions. For a 2 percent probability of occurrence in 50 years or an approximately 2,400 year return period event, a Peak Ground Acceleration (PGA) of 0.26 g can be calculated for the site, assuming a site class C designation. A 50% reduction in the PGA was made per recommendations by Hynes and Franklin[4] and others to account for time response effects resulting in a design PGA of 0.13 g.

A number of slope stability cases were analyzed to evaluate the proposed geometries. The starter dike to 5820' and proposed raises to 5860' were analyzed in a long term steady state condition. The upstream raises to 5860'were evaluated downstream using the pseudo-dynamic condition to evaluate dike behavior under unlikely earthquake loading. The downstream and upstream slopes of the dike were evaluated using end of construction (EOC) total stress parameters A summary of the various cases evaluated and the resulting factors of safety determined using SLIDE 6.025 are summarized in Table 1.

Table 1 – Summary of Slope Stability Modeling

Description of Analysis Case	**Static or Seismic**	**Failure Scenario**	**Long Term or EOC**	**Freeboard (ft)**	**Factor of Safety**	**Plate Number**
Section A-A' – Raise to 5820'	Static	Downstream	Long Term	2	1.7	E-2
Section A-A' – Raise to 5860'	Static	Downstream	Long Term	2	1.7	E-3
Section A-A' - Raise to 5860', Seismic	Seismic	Downstream	Long Term	2	1.2	E-4
Section A-A' - Raise to 5860' EOC	Static	Downstream	EOC	2	1.7	E-5
Section A-A' - Raise to 5860', upstream EOC	Static	Upstream	EOC	10	5.8	E-6
Section B-B' – Raise to 5820'	Static	Downstream	Long Term	2	2.1	E-7
Section B-B' – Raise to 5860'	Static	Downstream	Long Term	2	1.8	E-8
Section B-B' - Raise to 5860', Seismic	Seismic	Downstream	Long Term	2	1.3	E-9
Section B-B' - Raise to 5860' EOC	Static	Downstream	EOC	2	1.9	E-10
Section B-B' - Raise to 5860', upstream EOC	Static	Upstream	EOC	10	7.5	E-11

[4] **Hynes-Griffin and Franklin 1984,** Hynes-Griffin, M. E., and Franklin, A. G. 1984. "Rationalizing the Seismic Coefficient Method," Miscellaneous Paper GL-84-13, U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS.

Ten (10) foot raise configurations were evaluated for upstream static and pseudodynamic raises. Slope geometry for the slope using borrow incorporated a minimum 1.5H:1V upstream slope and a 2.5H:1V downstream slope. All crest widths would be 20 feet. A biaxial, 270 lb/in ultimate strength (ASTM D-4595 basis), woven, geofabric was used in supporting the upstream fill in the analyses.

As the results of the analyses presented in the Appendix in Plates E-2 through 11 all long term static minimum factors of safety calculated are greater than 1.5 and those under design pseudodynamic conditions are greater than 1.1.

6.5 DESIGN RECOMMENDATIONS

Recommended phases of construction are shown on the attached Design Drawings.
Phase I should consist of a starter dike to 5820' in the east drainage of the impoundment. The basin and upstream face of the impoundment should be lined with a HDPE liner.

Phase II should likewise consist of a starter dike to 5820' in the west drainage of the impoundment. It will likewise be lined with an HDPE liner which will extend eastward over the top of the ridge between the two basins.

A crest width of 20 feet is recommended to facilitate implementation of wheel berms and trafficability for maintenance equipment. A downstream slope of 2H: 1V, and an upstream slope of 3H:1V or flatter to facilitate liner installation is recommended for the starter dike. IGES, Inc. recommends a 40 mil HDPE liner similar in composition and characteristics to that used in the existing impoundment pond.

Phases III and IV should be a series of upstream raises constructed first on the east starter dike to an elevation of 5830', each subsequent raise will increase the elevation of the entire dam by 10 feet . The upstream face of the upstream raise should be lined with a GCL liner.

Upstream slopes in the GCL lined area will be constructed using a 1.5H:1V slope whereas the downstream slopes will be 2.5H:1V slope (see drawings in Appendix G for delineation of this typical section use).

Before starter dike ultimate storage capacity is reached, tailings discharge should be modified to facilitate future upstream expansion of the impoundment. The discharge pipeline should extend along the embankment crest. Discharge points need to be valved into the pipeline to facilitate managed distribution of tailings along the upstream face of the raised embankment.

Surface water (potential run-on) should be diverted away from the impoundment by means of a ditch. The ditch will bound the upslope perimeter of the proposed impoundment along the northern limits of the basin. The ditch will be on the upstream side of the proposed maintenance road. The ditch should be constructed such that it has 4 Horizontal to 1 Vertical side slopes, a 1 foot bottom width, and a 1.5 foot depth. Ditch geometry can be cut from existing site soils or built up with recompacted site soils.

Specifications for construction of the proposed raise are provided in Appendix F. The attached set of Design Drawings on Sheets 1 to 9 in Appendix G have been developed to depicting the proposed expansion design.

7.0 CLOSURE

7.1 LIMITATIONS

The recommendations contained in this report are based on our limited field exploration, laboratory testing, and understanding of the proposed construction. The subsurface data used in the preparation of this report were obtained from the explorations made for this investigation. It is possible that variations in the soil and groundwater conditions could exist between the points explored. The nature and extent of variations may not be evident until construction occurs. If any conditions are encountered at this site that are different from those described in this report, our firm should be immediately notified so that we may make any necessary revisions to recommendations contained in this report. In addition, if the scope of the proposed construction changes from that described in this report, our firm should also be notified. This report was prepared in accordance with the generally accepted standard of practice at the time the report was written. No warranty, expressed or implied, is made.

It is the Client's responsibility to see that all parties to the project including the Contractor, Subcontractors, etc. are made aware of this report in its entirety. The use of information contained in this report for bidding purposes should be done at the Contractor's option and risk.

7.2 ADDITIONAL SERVICES

The recommendations made in this report are based on the assumption that an adequate program of tests and observations will be made during the construction. IGES staff should be on site to verify compliance with these recommendations. These tests and observations should include, but not necessarily be limited to, the following:

- Observations and testing during site preparation, earthwork and structural fill placement.
- Consultation as may be required during construction.
- Quality control and observation of fill placement and liner construction.

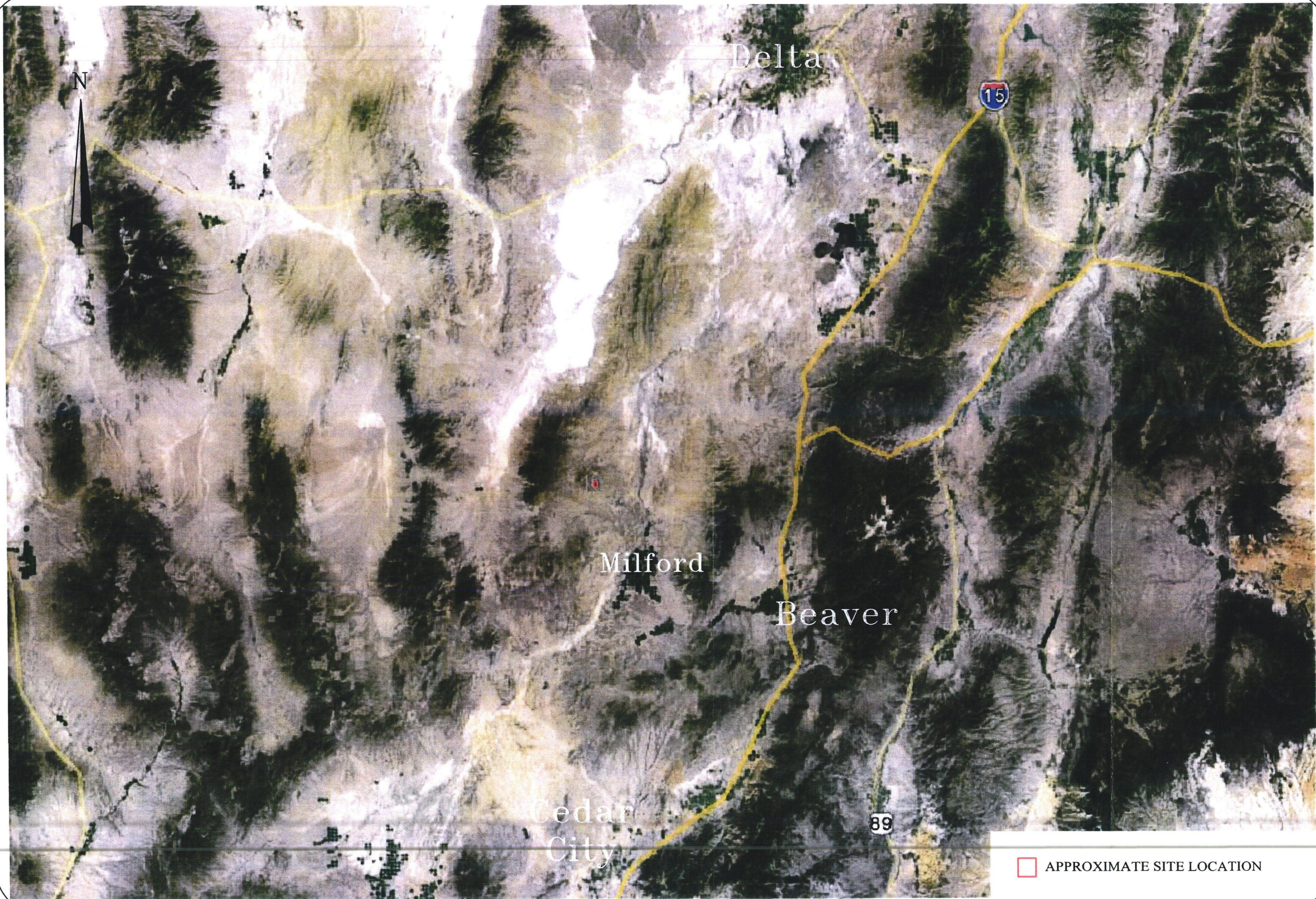
We appreciate the opportunity to be of service on this project. Should you have any questions regarding the report or wish to discuss additional services, please do not hesitate to contact us at your convenience (801) 270-9400.

Respectfully,
IGES, Inc.

PROFESSIONAL ENGINEER
JOHN F. WALLACE
157987
STATE OF UTAH

John F. Wallace, P.E., D.GE.
Principal

APPENDIX A



Copyright IGES 2014

Drawing Notes

Site Vicinity Map

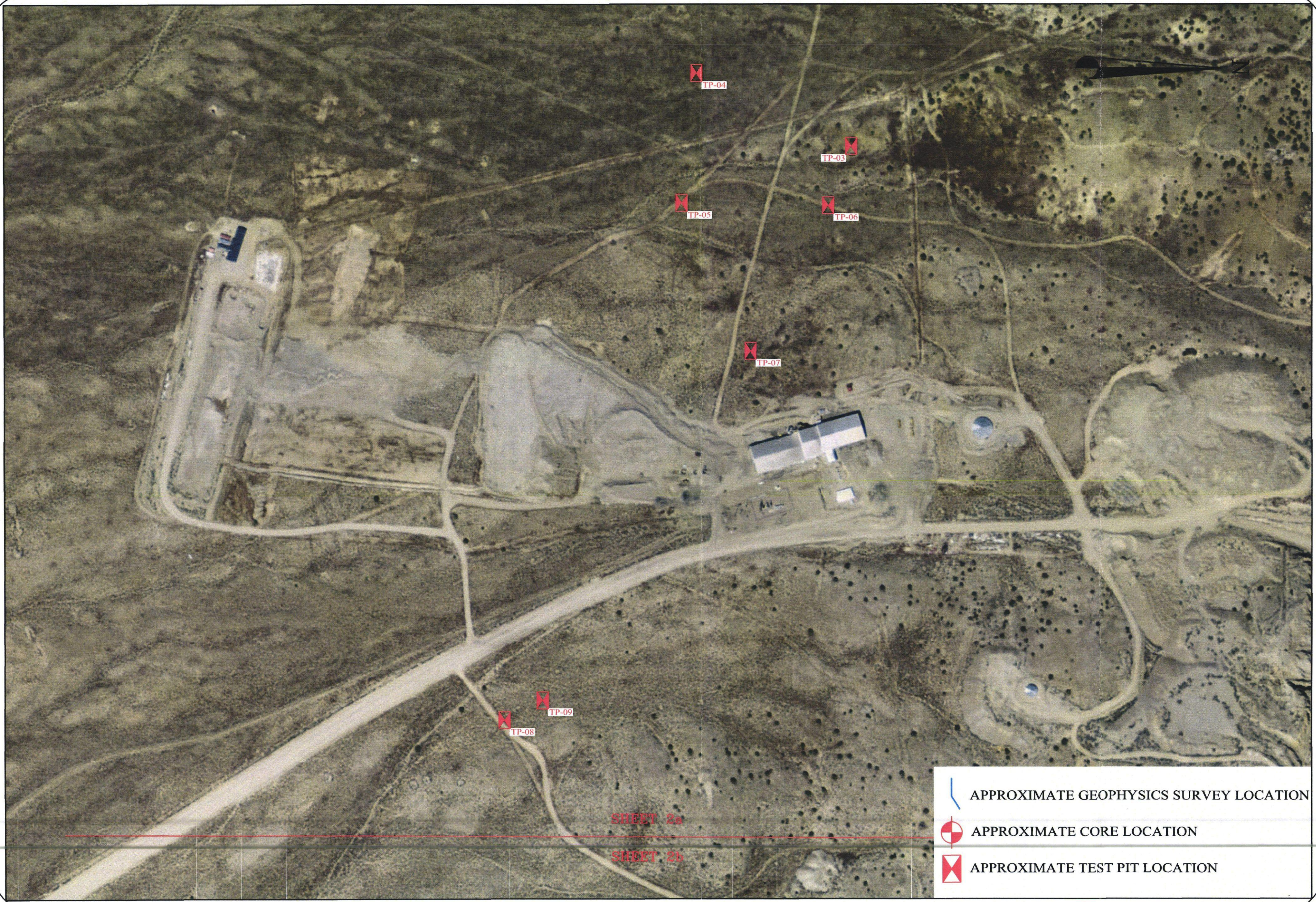
CS Mining
Plant Expansion
Beaver County
Utah

Project Number 01640-002

No.	Revision/Issue	Date

SHEET
A-1

JMG 8/8/13 I:\Projects\ CS Mining



IGES

Drawing Notes

Exploration Location Map

CS Mining
Plant Expansion
Beaver County
Utah

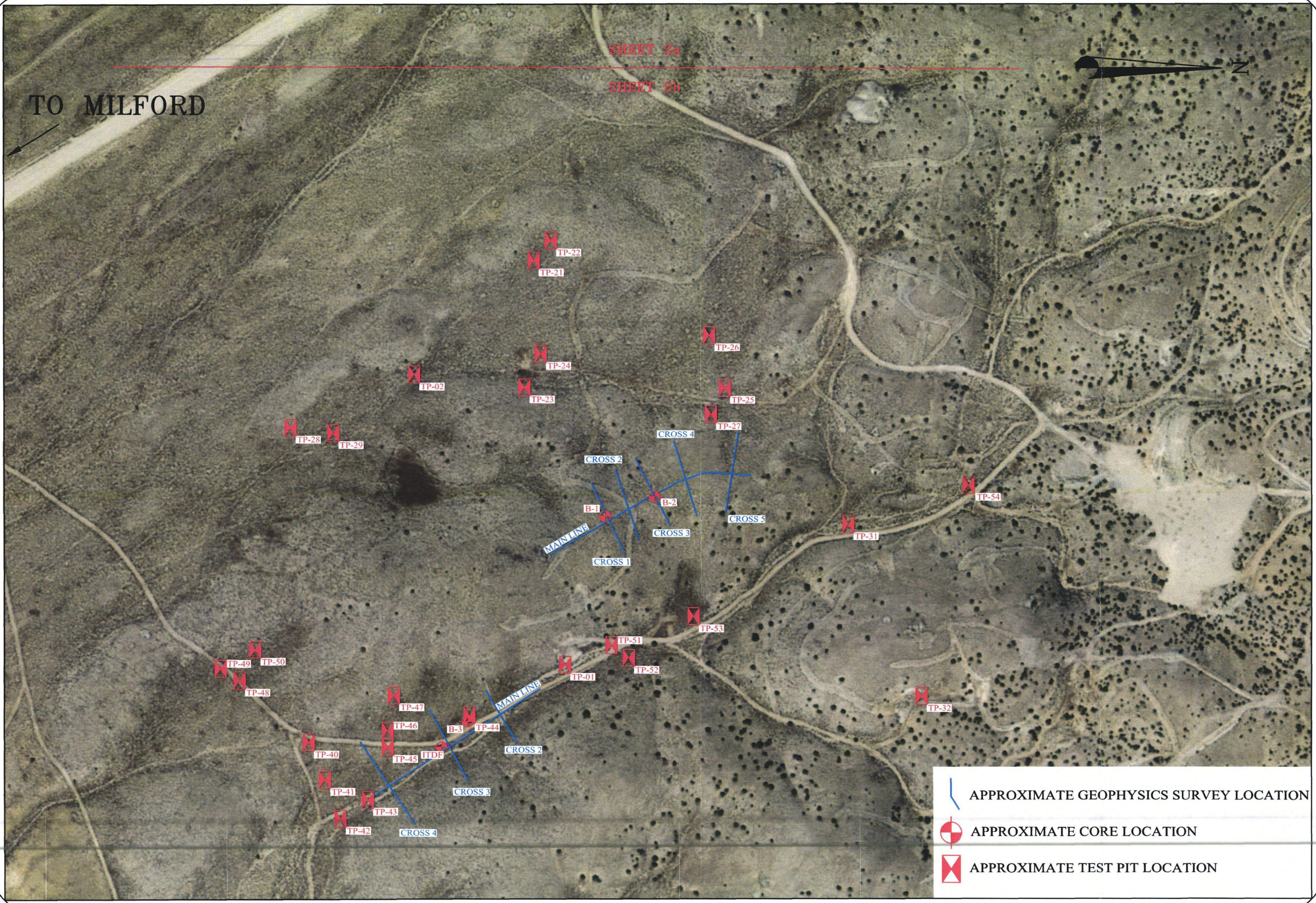
Project Number 01640-002

No.	Revision/Issue	Date

SHEET

A-2a

JMG 8/8/13 I:\Projects\ CS Mining



JMG 8/8/13 I:\Projects\ CS Mining

IGES

Drawing Notes

Exploration Location Map

CS Mining
Plant Expansion
Beaver County
Utah

Project Number 01640-002

No.	Revision/Issue	Date

SHEET

A-2b

APPENDIX B

DATE		
STARTED:	8/12/13	
COMPLETED:	8/13/13	
BACKFILLED:	8/13/13	

Geotechnical Investigation
CS Mining
Milford, UT

IGES Rep: DLB
Rig Type: Fraste
Boring Type: NQ3 core
Project Number: 01640-003

BORING NO: **B-1**
Sheet 1 of 2

LOCATION
NORTHING 4,261,441 EASTING 315,071 ELEVATION

DEPTH METERS	DEPTH FEET	SAMPLE TYPE	WATER LEVEL	RECOVERY PERCENT	RQD	DESCRIPTION OF ROCK QUALITY**	GRAPHICAL LOG	MATERIAL CLASSIFICATION	MATERIAL DESCRIPTION	N*	Dry Density(pcf)	Moisture Content %	Percent minus 200	Liquid Limit	Plasticity Index
0	0														
1															
	5			30	0	VP			GRANODIORITE (Tigd) - very fractured, coarse grained, copper oxide in joints						
2															
3	10			13	0	VP			-Fat clay in core						
4				100	0	VP									
	15			7	0	VP			- 15 feet to 19 feet decomposed						
5															
6	20			30	7	VP			- water staining in fractures, some slickensides, moderate to weak strength						
7															
	25			51	0	VP									
8				0	0	VP									
9															

* N - UNCORRECTED, EQUIVALENT SPT BLOW COUNT

IGES®

SAMPLE TYPE
- 2" O.D./1.38" I.D. SPLIT SPOON SAMPLER
- 3.25" O.D./2.42" I.D. U SAMPLER
- 3" O.D. THIN-WALLED SHELBY SAMPLER
- GRAB SAMPLE
- ROCK CORE SAMPLE

**RQD KEY
- 0-25% Very Poor (VP)
- 25-50% Poor (P)
- 50-75% Fair (F)
- 75-90% Good (G)
- 90-100% Excellent (E)

WATER LEVEL
▼- MEASURED ▽- ESTIMATED

Plate
B - 1a

DATE		
STARTED: 8/12/13		
COMPLETED: 8/13/13		
BACKFILLED: 8/13/13		

Geotechnical Investigation
CS Mining
Milford, UT

IGES Rep: DLB
Rig Type: Fraste
Boring Type: NQ3 core
Project Number: 01640-003

BORING NO: **B-1**
Sheet 2 of 2

LOCATION
NORTHING 4,261,441 EASTING 315,071 ELEVATION

DEPTH (FEET)	RECOVERY PERCENT	RQD	DESCRIPTION OF ROCK QUALITY**	MATERIAL DESCRIPTION
30	91	43	P	
	88	0	VP	- copper infill in fractures
35	96	54	F	
	96	61	F	
	100	36	P	
40	58	30	F	- weathered joints
45	92	74	F	
50				Bottom of Boring @ 50 Feet

Column headings: DEPTH (METERS, FEET), SAMPLE TYPE, WATER LEVEL, RECOVERY PERCENT, RQD, DESCRIPTION OF ROCK QUALITY**, GRAPHICAL LOG, MATERIAL CLASSIFICATION, MATERIAL DESCRIPTION, N*, Dry Density(pcf), Moisture Content %, Percent minus 200, Liquid Limit, Plasticity Index

Depth scale: FEET 30, 35, 40, 45, 50, 55; METERS 10, 11, 12, 13, 14, 15, 16, 17, 18

* N - UNCORRECTED, EQUIVALENT SPT BLOW COUNT

IGES®

SAMPLE TYPE
- 2" O.D./1.38" I.D. SPLIT SPOON SAMPLER
- 3.25" O.D./2.42" I.D. U SAMPLER
- 3" O.D. THIN-WALLED SHELBY SAMPLER
- GRAB SAMPLE
- ROCK CORE SAMPLE

**RQD KEY
- 0-25% Very Poor (VP)
- 25-50% Poor (P)
- 50-75% Fair (F)
- 75-90% Good (G)
- 90-100% Excellent (E)

WATER LEVEL
▼ - MEASURED ▽ - ESTIMATED

Plate **B - 1b**

DATE		Geotechnical Investigation CS Mining Milford, UT		BORING NO: B-2
	STARTED: 8/13/13		IGES Rep: DLB	Sheet 1 of 2
	COMPLETED: 8/13/13		Rig Type: Fraste	
	BACKFILLED: 8/13/13		Boring Type: NQ3 core	
			Project Number: 01640-003	

LOCATION

NORTHING 4,261,493 EASTING 315,045 ELEVATION

DEPTH METERS	DEPTH FEET	SAMPLE TYPE	WATER LEVEL	RECOVERY PERCENT	RQD	DESCRIPTION OF ROCK QUALITY**	GRAPHICAL LOG	MATERIAL CLASSIFICATION	MATERIAL DESCRIPTION	N*	Dry Density(pcf)	Moisture Content %	Percent minus 200	Liquid Limit	Plasticity Index
0	0														
1															
	5			47	0	VP			GRANODIORITE (Tigd) - very fractured, coarse grained, near vertical joints, copper oxide in joints						
2															
				85	38	P									
3	10			97	39	P									
4				82	48	F									
	15			45	15	VP			- copper oxide infill in joints						
5															
6	20			25	0	VP									
7															
	25			71	0										
8															
				0	0										
9															

* N - UNCORRECTED, EQUIVALENT SPT BLOW COUNT

IGES®

SAMPLE TYPE
- 2" O.D./1.38" I.D. SPLIT SPOON SAMPLER
- 3.25" O.D./2.42" I.D. U SAMPLER
- 3" O.D. THIN-WALLED SHELBY SAMPLER
- GRAB SAMPLE
- ROCK CORE SAMPLE

**RQD KEY
- 0-25% Very Poor (VP)
- 25-50% Poor (P)
- 50-75% Fair (F)
- 75-90% Good (G)
- 90-100% Excellent (E)

WATER LEVEL
▼ - MEASURED ▽ - ESTIMATED

Plate B - 2a

DATE	STARTED: 8/13/13	Geotechnical Investigation CS Mining Milford, UT	IGES Rep: DLB	BORING NO: B-2
	COMPLETED: 8/13/13		Rig Type: Fraste	Sheet 2 of
	BACKFILLED: 8/13/13		Boring Type: NQ3 core	
			Project Number: 01640-003	

LOCATION

NORTHING 4,261,493 EASTING 315,045 ELEVATION

DEPTH METERS	DEPTH FEET	SAMPLE TYPE	WATER LEVEL	RECOVERY PERCENT	RQD	DESCRIPTION OF ROCK QUALITY**	GRAPHICAL LOG	MATERIAL CLASSIFICATION	MATERIAL DESCRIPTION	N*	Dry Density(pcf)	Moisture Content %	Percent minus 200	Liquid Limit	Plasticity Index
	30			20	0	VP									
10															
	35			28	18	VP			- decomposed in sections of the core						
11															
12															
	40			100	48	P			- vertical joints filled with calcite						
13															
	45			27	15	VP									
14															
15															
	50								Bottom of Boring @ 50 Feet						
16															
	55														
17															
18															

* N - UNCORRECTED, EQUIVALENT SPT BLOW COUNT

IGES®

SAMPLE TYPE
- 2" O.D./1.38" I.D. SPLIT SPOON SAMPLER
- 3.25" O.D./2.42" I.D. U SAMPLER
- 3" O.D. THIN-WALLED SHELBY SAMPLER
- GRAB SAMPLE
- ROCK CORE SAMPLE

**RQD KEY
- 0-25% Very Poor (VP)
- 25-50% Poor (P)
- 50-75% Fair (F)
- 75-90% Good (G)
- 90-100% Excellent (E)

WATER LEVEL
▼ - MEASURED ▽ - ESTIMATED

Pla[te]
B - 2b

DATE	STARTED: 8/13/13	Geotechnical Investigation CS Mining Milford, UT	IGES Rep: DLB Rig Type: Fraste Boring Type: NQ3 core Project Number: 01640-003	BORING NO: **B-3** Sheet 1 of 2
	COMPLETED: 8/13/13			
	BACKFILLED: 8/13/13			

LOCATION

NORTHING 4,261,286 EASTING 315,302 ELEVATION

DEPTH (METERS)	DEPTH (FEET)	SAMPLE TYPE	WATER LEVEL	RECOVERY PERCENT	RQD	DESCRIPTION OF ROCK QUALITY**	GRAPHICAL LOG	MATERIAL CLASSIFICATION	MATERIAL DESCRIPTION	N*	Dry Density(pcf)	Moisture Content %	Percent minus 200	Liquid Limit	Plasticity Index
0	0							SC	Clayey SAND - dense, moist, light tan, matrix soil is fat clay						
1															
	5														
2															
3	10														
4									GRANODIORITE (Tigd) - very fractured, coarse grained, copper oxide in joints						
	15			37	8	VP									
5															
6	20			23	7	VP									
7															
	25			62	7	VP									
8															
9				60	32	P									

* N - UNCORRECTED, EQUIVALENT SPT BLOW COUNT

IGES®

SAMPLE TYPE
- 2" O.D./1.38" I.D. SPLIT SPOON SAMPLER
- 3.25" O.D./2.42" I.D. U SAMPLER
- 3" O.D. THIN-WALLED SHELBY SAMPLER
- GRAB SAMPLE
- ROCK CORE SAMPLE

**RQD KEY
0-25% Very Poor (VP)
25-50% Poor (P)
50-75% Fair (F)
75-90% Good (G)
90-100% Excellent (E)

WATER LEVEL
▼- MEASURED ▽- ESTIMATED

ROCK LOG - 4-LINE HEADER 01640-003.GPJ IGES.GDT 2/3/14

DATE	STARTED: 8/13/13	Geotechnical Investigation CS Mining	IGES Rep: DLB	BORING NO: B-3
	COMPLETED: 8/13/13		Rig Type: Fraste	
	BACKFILLED: 8/13/13	Milford, UT	Boring Type: NQ3 core Project Number: 01640-003	Sheet 2 of 2

LOCATION

NORTHING 4,261,286 EASTING 315,302 ELEVATION

DEPTH METERS	DEPTH FEET	SAMPLE TYPE	WATER LEVEL	RECOVERY PERCENT	RQD	DESCRIPTION OF ROCK QUALITY**	GRAPHICAL LOG	MATERIAL CLASSIFICATION	MATERIAL DESCRIPTION	N*	Dry Density(pcf)	Moisture Content %	Percent minus 200	Liquid Limit	Plasticity Index
	30														
10															
	35								Bottom of Boring @ 35 Feet						
11															
12	40														
13															
	45														
14															
15	50														
16															
	55														
17															
18															

* N - UNCORRECTED, EQUIVALENT SPT BLOW COUNT

IGES®

SAMPLE TYPE
- 2" O.D./1.38" I.D. SPLIT SPOON SAMPLER
- 3.25" O.D./2.42" I.D. U SAMPLER
- 3" O.D. THIN-WALLED SHELBY SAMPLER
- GRAB SAMPLE
- ROCK CORE SAMPLE

**RQD KEY

0-25%	Very Poor (VP)
25-50%	Poor (P)
50-75%	Fair (F)
75-90%	Good (G)
90-100%	Excellent (E)

WATER LEVEL
▼- MEASURED ▽- ESTIMATED

Plate
B - 3b

DATE	STARTED: 12/27/13	Geotechnical Investigation CS Mining Milford, UT	IGES Rep: CS Mining Rig Type: Boring Type: National - CORE Project Number: 01640-002	BORING NO: **ITDF** Sheet 1 of 3
	COMPLETED: 12/27/13			
	BACKFILLED: 12/27/13			

LOCATION: NORTHING | EASTING | ELEVATION

DEPTH (METERS)	DEPTH (FEET)	SAMPLE TYPE	WATER LEVEL	RECOVERY PERCENT	RQD	DESCRIPTION OF ROCK QUALITY**	GRAPHICAL LOG	MATERIAL CLASSIFICATION	MATERIAL DESCRIPTION	N*	Dry Density(pcf)	Moisture Content %	Percent minus 200	Liquid Limit	Plasticity Index
0	0			25	1			SM	Silty SAND - dense, dry, brown						
2				14	0	VP			- Alluvium						
4.5	15			48	27	P			Highly Weathered GRANODIORITE						
6	20								- altered zone						
7									GRANODIORITE - solid core						
8	25			75	21	VP									
9									- some clay						
9	30			136	0	VP			- dendritic black crystals, manganese						
10				153	26	P									
11	35			86	26	P			- some brown mica clay						
12	40			114	20	VP			- some weathering, staining on fractures						
13				105	58	F			- altered zone						
14	45								- decreasing clay						
15	50			100	40	P			GRANODIORITE - calcite on fractures						
17	55			115	44	P									
19				108	33	P									
21	70			108	70	F									
22				100	38	P									

* N - UNCORRECTED, EQUIVALENT SPT BLOW COUNT

IGES®

SAMPLE TYPE
- 2" O.D./1.38" I.D. SPLIT SPOON SAMPLER
- 3.25" O.D./2.42" I.D. U SAMPLER
- 3" O.D. THIN-WALLED SHELBY SAMPLER
- GRAB SAMPLE
- ROCK CORE SAMPLE

**RQD KEY
- 0-25% Very Poor (VP)
- 25-50% Poor (P)
- 50-75% Fair (F)
- 75-90% Good (G)
- 90-100% Excellent (E)

WATER LEVEL
▼ - MEASURED ▽ - ESTIMATED

Plate B - 4a

DATE		
	STARTED:	12/27/13
	COMPLETED:	12/27/13
	BACKFILLED:	12/27/13

Geotechnical Investigation
CS Mining
Milford, UT

IGES Rep: CS Mining
Rig Type:
Boring Type: National - CORE
Project Number: 01640-002

BORING NO: **ITDF**

LOCATION: NORTHING | EASTING | ELEVATION

Meters	Feet	Recovery Percent	RQD	Description of Rock Quality**	Material Description
23	75				
24		100	93	E	
	80	73	56	F	
25					
26	85				
27		50	0	VP	
	90	117	61	F	- some green mica clay
28		100	0	VP	
29	95	140	53	F	- alteration
30		25	0	VP	
	100				
31		86	35	P	
32	105				- more dendritic manganese
33		105	68	F	
	110				
34		100	80	G	
35	115				
36		100	45	P	
	120				
37		109	76	G	
38	125				
		100	67	F	
39		110	13	VP	- some clay GRANODIORITE - altered
40	130				
41	135				
42		104	19	VP	
43	140				
44	145				
45		90	53	F	- some clay GRANODIORITE - altered

Other columns: SAMPLE TYPE, WATER LEVEL, GRAPHICAL LOG, MATERIAL CLASSIFICATION, N*, Dry Density(pcf), Moisture Content %, Percent minus 200, Liquid Limit, Plasticity Index

* N - UNCORRECTED, EQUIVALENT SPT BLOW COUNT

SAMPLE TYPE
- 2" O.D./1.38" I.D. SPLIT SPOON SAMPLER
- 3.25" O.D./2.42" I.D. U SAMPLER
- 3" O.D. THIN-WALLED SHELBY SAMPLER
- GRAB SAMPLE
- ROCK CORE SAMPLE

**RQD KEY
- 0-25% Very Poor (VP)
- 25-50% Poor (P)
- 50-75% Fair (F)
- 75-90% Good (G)
- 90-100% Excellent (E)

WATER LEVEL
▼ - MEASURED ▽ - ESTIMATED

IGES®

Plate B - 4b

DATE	
STARTED:	12/27/13
COMPLETED:	12/27/13
BACKFILLED:	12/27/13

Geotechnical Investigation
CS Mining

Milford, UT

IGES Rep: CS Mining
Rig Type:
Boring Type: National - CORE
Project Number: 01640-002

BORING NO:
ITDF
Sheet 3 of 3

LOCATION
NORTHING EASTING ELEVATION

DEPTH METERS	DEPTH FEET	SAMPLE TYPE	WATER LEVEL	RECOVERY PERCENT	RQD	DESCRIPTION OF ROCK QUALITY**	GRAPHICAL LOG	MATERIAL CLASSIFICATION	MATERIAL DESCRIPTION	N*	Dry Density(pcf)	Moisture Content %	Percent minus 200	Liquid Limit	Plasticity Index
46	150														
47				110	50	F									
	155														
48				94	22	VP									
49	160			115	13	VP									
50	165			93	22	VP									
51															
52	170			125	45	P									
53	175			78	22	VP									
54				113	0	VP									
55	180			118	53	F									
56	185			158	0	VP			- black banding in fractures						
57				98	21	VP									
58	190			100	33	P									
59				78	28	P									
	195			156	44	P									
60				150	0	VP									
61	200								Bottom of Boring @ 199 Feet						
62															
63	205														
64	210														
65															
66	215														
67	220														
68															

* N - UNCORRECTED, EQUIVALENT SPT BLOW COUNT

IGES®

SAMPLE TYPE
- 2" O.D./1.38" I.D. SPLIT SPOON SAMPLER
- 3.25" O.D./2.42" I.D. U SAMPLER
- 3" O.D. THIN-WALLED SHELBY SAMPLER
- GRAB SAMPLE
- ROCK CORE SAMPLE

**RQD KEY

0-25%	Very Poor (VP)
25-50%	Poor (P)
50-75%	Fair (F)
75-90%	Good (G)
90-100%	Excellent (E)

WATER LEVEL
▼ - MEASURED ▽ - ESTIMATED

Plate
B - 4c

DATE		Geotechnical Investigation CS Mining Milford, UT Project Number 01640-003	IGES Rep: NB Rig Type: Backhoe	TEST PIT NO: TP-01 Sheet 1 of 1
	STARTED: 3/7/13			
	COMPLETED: 3/7/13			
	BACKFILLED: 3/7/13			

LOCATION

NORTHING EASTING ELEVATION

DEPTH METERS	DEPTH FEET	SAMPLES	WATER LEVEL	GRAPHICAL LOG	UNIFIED SOIL CLASSIFICATION	MATERIAL DESCRIPTION	Dry Density(pcf)	Moisture Content %	Percent minus 200	Liquid Limit	Plasticity Index	Moisture Content and Atterberg Limits (Plastic Limit, Moisture Content, Liquid Limit; 10 20 30 40 50 60 70 80 90)
0	0				SW	Well Graded SAND - loose to medium dense, moist, brown, some gravel 2 to 3"						
									4			
1	5											
2						Granodiorite material						
									5			
					SW	Well Graded SAND with gravel - medium dense, moist, grey brown mottled						
3	10					Bottom of Test Pit @ 9.5 Feet						

LOG OF TEST PITS (A)_SIMPLIFIED 01640-003.GPJ IGES.GDT 2/3/14

IGES®

SAMPLE TYPE
- GRAB SAMPLE
- 3" O.D. THIN-WALLED HAND SAMPLER

WATER LEVEL
▼- MEASURED
▽- ESTIMATED

NOTES:

Plate
B - 5

DATE		Geotechnical Investigation CS Mining Milford, UT Project Number 01640-002	IGES Rep: NB Rig Type: Backhoe	TEST PIT NO **TP-02** Sheet 1 of 1
STARTED:	3/7/13			
COMPLETED:	3/7/13			
BACKFILLED:	3/7/13			

LOCATION: NORTHING / EASTING / ELEVATION

DEPTH (METERS)	DEPTH (FEET)	SAMPLES	WATER LEVEL	GRAPHICAL LOG	UNIFIED SOIL CLASSIFICATION	MATERIAL DESCRIPTION	Dry Density(pcf)	Moisture Content %	Percent minus 200	Liquid Limit	Plasticity Index	Moisture Content and Atterberg Limits (Plastic Limit / Moisture Content / Liquid Limit) 10 20 30 40 50 60 70 80 90
0	0				SM	Silty SAND - loose, dry, light brown, sand is fine						
		Grab				Silty SAND - loose to medium dense, dry, light brown, sand is fine			15			
1												
	5											
2		Grab			SW	Well Graded SAND - medium dense, dry, grey to brown			6			
						Bottom of Test Pit @ 8 Feet						
3	10											

IGES®

SAMPLE TYPE
- GRAB SAMPLE
- 3" O.D. THIN-WALLED HAND SAMPLER

WATER LEVEL
- ▼- MEASURED
- ▽- ESTIMATED

NOTES:

DATE		Geotechnical Investigation CS Mining Milford, UT	IGES Rep: NB	TEST PIT NO:
STARTED:	3/7/13		Rig Type: Backhoe	**TP-03**
COMPLETED:	3/7/13			Sheet 1 of 1
BACKFILLED	3/7/13	Project Number 01640-001		

LOCATION

NORTHING | EASTING | ELEVATION

DEPTH METERS	DEPTH FEET	SAMPLES	WATER LEVEL	GRAPHICAL LOG	UNIFIED SOIL CLASSIFICATION	MATERIAL DESCRIPTION	Dry Density(pcf)	Moisture Content %	Percent minus 200	Liquid Limit	Plasticity Index	Moisture Content and Atterberg Limits (Plastic Limit, Moisture Content, Liquid Limit) 10 20 30 40 50 60 70 80 90
0	0					TOPSOIL						
					SM	Silty SAND with gravel and cobbles - medium dense, dry, light brown						
1												
	5											
2						Bottom of Test Pit @ 6.5 Feet						
3												

LOG OF TEST PITS (A) SIMPLIFIED 01640-001.GPJ IGES.GDT 2/3/14

IGES®

SAMPLE TYPE
- [] - GRAB SAMPLE
- ■ - 3" O.D. THIN-WALLED HAND SAMPLER

WATER LEVEL
- ▼- MEASURED
- ▽- ESTIMATED

NOTES:

Plate **B - 7**

DATE			
STARTED: 3/7/13	Geotechnical Investigation CS Mining Milford, UT	IGES Rep: NB	TEST PIT NO: **TP-04**
COMPLETED: 3/7/13		Rig Type: Backhoe	Sheet 1 of 1
BACKFILLED: 3/7/13	Project Number 01640-001		

LOCATION

NORTHING | EASTING | ELEVATION

DEPTH (METERS)	DEPTH (FEET)	SAMPLES	WATER LEVEL	GRAPHICAL LOG	UNIFIED SOIL CLASSIFICATION	MATERIAL DESCRIPTION	Dry Density(pcf)	Moisture Content %	Percent minus 200	Liquid Limit	Plasticity Index	Moisture Content and Atterberg Limits (Plastic Limit, Moisture Content, Liquid Limit; 10 20 30 40 50 60 70 80 90)
0	0					TOPSOIL						
1					SC	Clayey SAND with gravel and cobbles - medium dense, moist, light brown						
									31	28	11	
	5					Clayey SAND with gravel and cobbles - medium dense, moist						
									15	35	12	
2						Bottom of Test Pit @ 6 Feet						
3												

SAMPLE TYPE
- GRAB SAMPLE
- 3" O.D. THIN-WALLED HAND SAMPLER

WATER LEVEL
- MEASURED
- ESTIMATED

NOTES:

Plate B - 8

DATE	
STARTED:	3/7/13
COMPLETED:	3/7/13
BACKFILLED:	3/7/13

Geotechnical Investigation
CS Mining
Milford, UT
Project Number 01640-001

IGES Rep: NB
Rig Type: Backhoe

TEST PIT NO: **TP-05**
Sheet 1 of 1

LOCATION
NORTHING EASTING ELEVATION

DEPTH METERS	DEPTH FEET	SAMPLES	WATER LEVEL	GRAPHICAL LOG	UNIFIED SOIL CLASSIFICATION	MATERIAL DESCRIPTION	Dry Density(pcf)	Moisture Content %	Percent minus 200	Liquid Limit	Plasticity Index	Moisture Content and Atterberg Limits (Plastic Limit, Moisture Content, Liquid Limit; 10 20 30 40 50 60 70 80 90)
0	0					TOPSOIL						
					SM	Silty SAND with gravel and cobbles - loose to medium dense, moist, light brown						
						SILT with sand - medium stiff, dry, light brown and grey, pinholes						
1					SM	Silty SAND with gravel and cobbles - medium dense, moist, light brown to medium brown, pinholes decreasing with depth, sand is fine						
	5											
2						Silty SAND with gravel - medium dense, moist, brown, sand is fine						
						Bottom of Test Pit @ 7 Feet						
3												

LOG OF TEST PITS (A) SIMPLIFIED 01640-001.GPJ IGES.GDT 2/3/14

IGES®

SAMPLE TYPE
- GRAB SAMPLE
- 3" O.D. THIN-WALLED HAND SAMPLER

WATER LEVEL
▼- MEASURED
▽- ESTIMATED

NOTES:

Plate
B - 9

DATE		
STARTED: 3/7/13	COMPLETED: 3/7/13	BACKFILLED: 3/7/13

Geotechnical Investigation
CS Mining
Milford, UT
Project Number 01640-001

IGES Rep: NB
Rig Type: Backhoe

TEST PIT NO: **TP-06**
Sheet 1 of 1

LOCATION: NORTHING | EASTING | ELEVATION

MATERIAL DESCRIPTION

DEPTH METERS	DEPTH FEET	UNIFIED SOIL CLASSIFICATION	MATERIAL DESCRIPTION	Dry Density(pcf)	Moisture Content %	Percent minus 200	Liquid Limit	Plasticity Index
0	0		TOPSOIL					
		SM	Silty SAND with gravel - medium dense, moist, light brown, sand is fine					
1		ML	SILT with gravel and sand - medium dense, moist to dry, light brown, some cementation, pinholes					
	5		Caliche					
2			Bottom of Test Pit @ 6.5 Feet					
3								

Moisture Content and Atterberg Limits: Plastic Limit, Moisture Content, Liquid Limit — 10 20 30 40 50 60 70 80 90

SAMPLES | WATER LEVEL | GRAPHICAL LOG

IGES®

SAMPLE TYPE
- GRAB SAMPLE
- 3" O.D. THIN-WALLED HAND SAMPLER

WATER LEVEL
- MEASURED
- ESTIMATED

NOTES:

Plate B - 10

DATE	
STARTED:	3/7/13
COMPLETED:	3/7/13
BACKFILLED:	3/7/13

Geotechnical Investigation
CS Mining
Milford, UT
Project Number 01640-001

IGES Rep: NB
Rig Type: Backhoe

TEST PIT NO: **TP-07**
Sheet 1 of 1

LOCATION
NORTHING EASTING ELEVATION

DEPTH METERS	DEPTH FEET	SAMPLES	WATER LEVEL	GRAPHICAL LOG	UNIFIED SOIL CLASSIFICATION	MATERIAL DESCRIPTION	Dry Density(pcf)	Moisture Content %	Percent minus 200	Liquid Limit	Plasticity Index	Moisture Content and Atterberg Limits (Plastic Limit / Moisture Content / Liquid Limit; 10 20 30 40 50 60 70 80 90)
0	0					TOPSOIL						
					SP-SM	Poorly Graded SAND with cobbles and silt - angular blocky granite, cobbles, decomposing granite			7	NP	NP	
1						Refusal Bottom of Test Pit @ 3.5 Feet						
	5											
2												
3												

IGES®

SAMPLE TYPE
- GRAB SAMPLE
- 3" O.D. THIN-WALLED HAND SAMPLER

WATER LEVEL
▼ - MEASURED
▽ - ESTIMATED

NOTES:

Plate
B - 11

DATE		Project		TEST PIT NO:
STARTED: 3/7/13	COMPLETED: 3/7/13	BACKFILLED: 3/7/13		

Geotechnical Investigation
CS Mining
Milford, UT
Project Number 01640-001

IGES Rep: NB
Rig Type: Backhoe

TEST PIT NO: **TP-08**
Sheet 1 of 1

LOCATION: NORTHING | EASTING | ELEVATION

DEPTH METERS	DEPTH FEET	SAMPLES	WATER LEVEL	GRAPHICAL LOG	UNIFIED SOIL CLASSIFICATION	MATERIAL DESCRIPTION	Dry Density(pcf)	Moisture Content %	Percent minus 200	Liquid Limit	Plasticity Index
0	0					TOPSOIL					
					SM	Silty SAND with silt - loose to medium dense, moist, brown, some gravel					
1						Silty Graded SAND with silt - medium dense, moist, brown, some gravel			16	NP	NP
	5										
2						Silty Graded SAND with silt and cobbles - dense, moist, light brown with grey					
						Bottom of Test Pit @ 7 Feet					
3											

Moisture Content and Atterberg Limits: Plastic Limit, Moisture Content, Liquid Limit — 10 20 30 40 50 60 70 80 90

IGES

SAMPLE TYPE
- GRAB SAMPLE
- 3" O.D. THIN-WALLED HAND SAMPLER

WATER LEVEL
- MEASURED
- ESTIMATED

NOTES:

Plate B - 12

DATE	
STARTED	3/7/13
COMPLETED	3/7/13
BACKFILLED	3/7/13

Geotechnical Investigation
CS Mining
Milford, UT
Project Number 01640-001

IGES Rep: NB
Rig Type: Backhoe

TEST PIT NO: **TP-09**
Sheet 1 of 1

LOCATION: NORTHING | EASTING | ELEVATION

Moisture Content and Atterberg Limits: Plastic Limit — Moisture Content — Liquid Limit (10 20 30 40 50 60 70 80 90)

DEPTH METERS	DEPTH FEET	SAMPLES	WATER LEVEL	GRAPHICAL LOG	UNIFIED SOIL CLASSIFICATION	MATERIAL DESCRIPTION	Dry Density(pcf)	Moisture Content %	Percent minus 200	Liquid Limit	Plasticity Index
0	0					TOPSOIL					
					SP-SM	Poorly Graded SAND with silt and gravel - loose to medium dense, moist, dark brown					
1					SM	Silty SAND - loose to medium dense, moist, light brown			19	NP	NP
	5					Some Granite Encountered					
2						Bottom of Test Pit @ 6 Feet					
3											

SAMPLE TYPE
- GRAB SAMPLE
- 3" O.D. THIN-WALLED HAND SAMPLER

WATER LEVEL
- MEASURED
- ESTIMATED

NOTES:

Plate **B - 13**

DATE	
STARTED:	3/26/13
COMPLETED:	3/26/13
BACKFILLED:	3/26/13

Geotechnical Investigation
CS Mining
Milford, UT
Project Number 01640-002

IGES Rep: JFW
Rig Type: Backhoe

TEST PIT NO: **TP-21**
Sheet 1 of 1

LOCATION
NORTHING 4,261,358 EASTING 314,793 ELEVATION

DEPTH (METERS)	DEPTH (FEET)	SAMPLES	WATER LEVEL	UNIFIED SOIL CLASSIFICATION	MATERIAL DESCRIPTION	Dry Density(pcf)	Moisture Content %	Percent minus 200	Liquid Limit	Plasticity Index
0	0				TOPSOIL - SILT to SAND - dark brown, sand is fine					
				SP-SM	Poorly Graded SAND with some silt - brown, sand is fine to medium					
1										
	5	Grab sample		SP	Poorly Graded SAND - brown, medium to coarse sand, some silt, some gravel, decomposed granidiorite					
2					Bottom of Test Pit @ 6 Feet					
3	10									

Moisture Content and Atterberg Limits
Plastic Limit — Moisture Content — Liquid Limit
10 20 30 40 50 60 70 80 90

IGES®

SAMPLE TYPE
- GRAB SAMPLE
- 3" O.D. THIN-WALLED HAND SAMPLER

WATER LEVEL
- MEASURED
- ESTIMATED

NOTES:

Plate B - 14

DATE	
STARTED:	3/26/13
COMPLETED:	3/26/13
BACKFILLED:	3/26/13

Geotechnical Investigation
CS Mining
Milford, UT
Project Number 01640-002

IGES Rep: JFW
Rig Type: Backhoe

TEST PIT NO:
TP-22
Sheet 1 of 1

LOCATION
NORTHING 4,261,377 EASTING 314,771 ELEVATION

DEPTH METERS	DEPTH FEET	SAMPLES	WATER LEVEL	GRAPHICAL LOG	UNIFIED SOIL CLASSIFICATION	MATERIAL DESCRIPTION	Dry Density(pcf)	Moisture Content %	Percent minus 200	Liquid Limit	Plasticity Index	Moisture Content and Atterberg Limits (Plastic Limit, Moisture Content, Liquid Limit) 10 20 30 40 50 60 70 80 90
0	0					TOPSOIL						
					SM	Silty SAND - medium dense, brown, sand is fine						
1												
					SP	Poorly Graded SAND - brown, transitioning into decomposed granidiorite - hard, less weathered, grading to gravel						
	5											
2						Bottom of Test Pit @ 6 Feet						
3	10											

SAMPLE TYPE
- GRAB SAMPLE
- 3" O.D. THIN-WALLED HAND SAMPLER

WATER LEVEL
- ▼- MEASURED
- ▽- ESTIMATED

NOTES:

Pla[te]
B - 15

DATE				
STARTED: 3/26/13	Geotechnical Investigation CS Mining Milford, UT	IGES Rep: JFW	TEST PIT NO:
COMPLETED: 3/26/13		Rig Type: Backhoe	TP-23
BACKFILLED: 3/26/13	Project Number 01640-002		Sheet 1 of 1

LOCATION

NORTHING 4,261,348 EASTING 314,933 ELEVATION

DEPTH METERS	DEPTH FEET	SAMPLES	WATER LEVEL	GRAPHICAL LOG	UNIFIED SOIL CLASSIFICATION	MATERIAL DESCRIPTION	Dry Density(pcf)	Moisture Content %	Percent minus 200	Liquid Limit	Plasticity Index	Moisture Content and Atterberg Limits (Plastic Limit, Moisture Content, Liquid Limit) 10 20 30 40 50 60 70 80 90
0	0					TOPSOIL - SILT to Silty SAND						
						Weathered GRANIDIORITE - grey, hard, fractured, somewhat weathered						
						Bottom of Test Pit @ 2.5 Feet						
1												
	5											
2												
3	10											

IGES®

SAMPLE TYPE
- GRAB SAMPLE
- 3" O.D. THIN-WALLED HAND SAMPLER

WATER LEVEL
- MEASURED
- ESTIMATED

NOTES:

Plate

B - 16

DATE		
STARTED:	3/26/13	
COMPLETED:	3/26/13	
BACKFILLED:	3/26/13	

Geotechnical Investigation
CS Mining
Milford, UT
Project Number 01640-002

IGES Rep: JFW
Rig Type: Backhoe

TEST PIT NO:
TP-24
Sheet 1 of 1

LOCATION
NORTHING 4,261,366 EASTING 314,896 ELEVATION

DEPTH METERS	DEPTH FEET	SAMPLES	WATER LEVEL	GRAPHICAL LOG	UNIFIED SOIL CLASSIFICATION	MATERIAL DESCRIPTION	Dry Density(pcf)	Moisture Content %	Percent minus 200	Liquid Limit	Plasticity Index	Moisture Content and Atterberg Limits (Plastic Limit, Moisture Content, Liquid Limit) 10 20 30 40 50 60 70 80 90
0	0					TOPSOIL						
					SM	Silty SAND - medium dense, brown, fine to medium sand						
1					SP-SM	Poorly Graded SAND with some silt - dense, grey brown, decomposed granidiorite						
	5					- grading to harder granidiorite, but still crushes in hand						
2												
						- difficult digging						
						Bottom of Test Pit @ 6 Feet						
3	10											

SAMPLE TYPE
- GRAB SAMPLE
- 3" O.D. THIN-WALLED HAND SAMPLER

WATER LEVEL
- MEASURED
- ESTIMATED

NOTES:

Pla
B - 17

DATE	
STARTED:	3/26/13
COMPLETED:	3/26/13
BACKFILLED:	3/26/13

Geotechnical Investigation
CS Mining
Milford, UT
Project Number 01640-002

IGES Rep: JFW
Rig Type: Backhoe

TEST PIT NO:
TP-25
Sheet 1 of 1

LOCATION
NORTHING 4,261,568 EASTING 314,933 ELEVATION

DEPTH METERS	DEPTH FEET	SAMPLES	WATER LEVEL	GRAPHICAL LOG	UNIFIED SOIL CLASSIFICATION	MATERIAL DESCRIPTION	Dry Density(pcf)	Moisture Content %	Percent minus 200	Liquid Limit	Plasticity Index	Moisture Content and Atterberg Limits (Plastic Limit / Moisture Content / Liquid Limit; 10 20 30 40 50 60 70 80 90)
0	0					TOPSOIL						
		Grab sample			SM	Silty SAND - brown, fine to medium sand						
1		Grab sample				Silty SAND - grading to grey brown, weathered granidiorite - hard digging						
	5					Bottom of Test Pit @ 5 Feet						
2												
3	10											

IGES®

SAMPLE TYPE
- GRAB SAMPLE
- 3" O.D. THIN-WALLED HAND SAMPLER

WATER LEVEL
- ▼ - MEASURED
- ▽ - ESTIMATED

NOTES:

Plate
B - 18

DATE	
STARTED:	3/26/13
COMPLETED:	3/26/13
BACKFILLED:	3/26/13

Geotechnical Investigation
CS Mining
Milford, UT
Project Number 01640-002

IGES Rep: JFW
Rig Type: Backhoe

TEST PIT NO:
TP-26
Sheet 1 of 1

LOCATION
NORTHING 4,261,551 EASTING 314,875 ELEVATION

DEPTH METERS	DEPTH FEET	SAMPLES	WATER LEVEL	GRAPHICAL LOG	UNIFIED SOIL CLASSIFICATION	MATERIAL DESCRIPTION	Dry Density(pcf)	Moisture Content %	Percent minus 200	Liquid Limit	Plasticity Index	Moisture Content and Atterberg Limits (Plastic Limit / Moisture Content / Liquid Limit) 10 20 30 40 50 60 70 80 90
0	0				ML	TOPSOIL						
					ML-SM	SILT to Silty SAND - brown, sand is fine, micaceous						
		Grab sample										
1												
	5					- grading to more sand						
2												
						BEDROCK - Quartz Monzonite - grading to brown highly weathered bedrock, fine grained						
3	10					- hard rock						
						Bottom of Test Pit @ 10 Feet						

SAMPLE TYPE
- GRAB SAMPLE
- 3" O.D. THIN-WALLED HAND SAMPLER

WATER LEVEL
▼- MEASURED
▽- ESTIMATED

NOTES:

Pla[te]
B - 19

DATE			
STARTED: 3/26/13	Geotechnical Investigation CS Mining Milford, UT Project Number 01640-002	IGES Rep: JFW Rig Type: Backhoe	TEST PIT NO: **TP-27** Sheet 1 of 1
COMPLETED: 3/26/13			
BACKFILLED: 3/26/13			

LOCATION

NORTHING 4,261,553 EASTING 314,962 ELEVATION

DEPTH METERS	DEPTH FEET	SAMPLES	WATER LEVEL	GRAPHICAL LOG	UNIFIED SOIL CLASSIFICATION	MATERIAL DESCRIPTION	Dry Density(pcf)	Moisture Content %	Percent minus 200	Liquid Limit	Plasticity Index	Moisture Content and Atterberg Limits (Plastic Limit, Moisture Content, Liquid Limit) 10 20 30 40 50 60 70 80 90
0	0					TOPSOIL						
					SM	Silty SAND - brown, fine sand						
						Weathered Granidiorite - grey, coarse grained, more quartz						
1						Bottom of Test Pit @ 3.5 Feet						
	5											
2												
3	10											

LOG OF TEST PITS (A) _SIMPLIFIED 01640-002.GPJ IGES.GDT 2/3/14

IGES®

SAMPLE TYPE
- GRAB SAMPLE
- 3" O.D. THIN-WALLED HAND SAMPLER

WATER LEVEL
- ▼ - MEASURED
- ▽ - ESTIMATED

NOTES:

Plate

B - 20

DATE	
STARTED:	3/26/13
COMPLETED:	3/26/13
BACKFILLED:	3/26/13

Geotechnical Investigation
CS Mining
Milford, UT
Project Number 01640-002

IGES Rep: JFW
Rig Type: Backhoe

TEST PIT NO:
TP-28
Sheet 1 of 1

LOCATION
NORTHING 4,261,091 EASTING 314,978 ELEVATION

DEPTH METERS	DEPTH FEET	SAMPLES	WATER LEVEL	GRAPHICAL LOG	UNIFIED SOIL CLASSIFICATION	MATERIAL DESCRIPTION	Dry Density(pcf)	Moisture Content %	Percent minus 200	Liquid Limit	Plasticity Index	Moisture Content and Atterberg Limits (Plastic Limit, Moisture Content, Liquid Limit) 10 20 30 40 50 60 70 80 90
0	0				ML	Sandy SILT - TOPSOIL - loose, dark brown						
					SM	Silty SAND - brown, sand is fine, decomposed bedrock						
					SP-SM	Weathered Granidiorite - grey						
1												
						Bottom of Test Pit @ 3.5 Feet						
	5											
2												
3	10											

IGES®

SAMPLE TYPE
- GRAB SAMPLE
- 3" O.D. THIN-WALLED HAND SAMPLER

WATER LEVEL
- MEASURED
- ESTIMATED

NOTES:

Pla[redacted]

B - 21

DATE	
STARTED:	3/26/13
COMPLETED:	3/26/13
BACKFILLED:	3/26/13

Geotechnical Investigation
CS Mining
Milford, UT
Project Number 01640-002

IGES Rep: JFW
Rig Type: Backhoe

TEST PIT NO:
TP-29
Sheet 1 of 1

LOCATION
NORTHING 4,261,138 EASTING 314,984 ELEVATION

DEPTH METERS	DEPTH FEET	SAMPLES	WATER LEVEL	GRAPHICAL LOG	UNIFIED SOIL CLASSIFICATION	MATERIAL DESCRIPTION	Dry Density(pcf)	Moisture Content %	Percent minus 200	Liquid Limit	Plasticity Index	Moisture Content and Atterberg Limits (Plastic Limit / Moisture Content / Liquid Limit) 10 20 30 40 50 60 70 80 90
0	0				ML	TOPSOIL						
					SM	Silty SAND - brown, sand is fine, dense						
1												
	5											
						- Bedrock						
						Bottom of Test Pit @ 5.5 Feet						
2												
3	10											

IGES®

SAMPLE TYPE
- GRAB SAMPLE
- 3" O.D. THIN-WALLED HAND SAMPLER

WATER LEVEL
- MEASURED
- ESTIMATED

NOTES:

Plate
B - 22

DATE	
STARTED:	3/26/13
COMPLETED:	3/26/13
BACKFILLED:	3/26/13

Geotechnical Investigation
CS Mining
Milford, UT

Project Number 01640-003

IGES Rep: JFW

Rig Type: Backhoe

TEST PIT NO:

TP-31

Sheet 1 of

LOCATION

NORTHING 4,261,704 EASTING 315,083 ELEVATION

DEPTH METERS	DEPTH FEET	SAMPLES	WATER LEVEL	GRAPHICAL LOG	UNIFIED SOIL CLASSIFICATION	MATERIAL DESCRIPTION	Dry Density(pcf)	Moisture Content %	Percent minus 200	Liquid Limit	Plasticity Index	Moisture Content and Atterberg Limits (Plastic Limit, Moisture Content, Liquid Limit; 10 20 30 40 50 60 70 80 90)
0	0					TOPSOIL with full cobble						
		Grab sample			SP-SM	Poorly Graded SAND with some silt and gravel - brown, coarse sand and gravel						
1												
	5											
2		Grab sample										
3	10					Bottom of Test Pit @ 10 Feet						

IGES®

SAMPLE TYPE
- GRAB SAMPLE
- 3" O.D. THIN-WALLED HAND SAMPLER

WATER LEVEL
- MEASURED
- ESTIMATED

NOTES:

Pla

B - 23

DATE	
STARTED:	3/26/13
COMPLETED:	3/26/13
BACKFILLED:	3/26/13

Geotechnical Investigation
CS Mining
Milford, UT
Project Number 01640-003

IGES Rep: JFW
Rig Type: Backhoe

TEST PIT NO:
TP-32
Sheet 1 of 1

LOCATION
NORTHING 4,261,785 EASTING 315,272 ELEVATION

DEPTH METERS	DEPTH FEET	SAMPLES	WATER LEVEL	GRAPHICAL LOG	UNIFIED SOIL CLASSIFICATION	MATERIAL DESCRIPTION	Dry Density(pcf)	Moisture Content %	Percent minus 200	Liquid Limit	Plasticity Index	Moisture Content and Atterberg Limits (Plastic Limit, Moisture Content, Liquid Limit; 10 20 30 40 50 60 70 80 90)
0	0					TOPSOIL						
					SP-SM	Poorly Graded SAND with some silt and gravel - dense, brown, fine to coarse sand, fine to coarse gravel, occasional angular cobble						
1					SP	Poorly Graded SAND with gravel and cobble - tan, fine to coarse sand, trace silt						
	5											
2					SP	Poorly Graded SAND with gravel - brown, occasional cobble, trace silt, subangular to subrounded, fine to coarse sand						
						Bottom of Test Pit @ 9 Feet						
3	10											

IGES®

SAMPLE TYPE
- GRAB SAMPLE
- 3" O.D. THIN-WALLED HAND SAMPLER

WATER LEVEL
- MEASURED
- ESTIMATED

NOTES:

Plate
B - 24

DATE		Geotechnical Investigation CS Mining Milford, UT Project Number 01640-003	IGES Rep: JFW Rig Type: Backhoe	TEST PIT NO: TP-40 Sheet 1 of 1
STARTED:	8/7/13			
COMPLETED:	8/7/13			
BACKFILLED:	8/7/13			

LOCATION

NORTHING 4,261,111 EASTING 315,325 ELEVATION

DEPTH METERS	DEPTH FEET	SAMPLES	WATER LEVEL	GRAPHICAL LOG	UNIFIED SOIL CLASSIFICATION	MATERIAL DESCRIPTION	Dry Density(pcf)	Moisture Content %	Percent minus 200	Liquid Limit	Plasticity Index	Moisture Content and Atterberg Limits (Plastic Limit, Moisture Content, Liquid Limit) 10 20 30 40 50 60 70 80 90
0	0				SM	Silty SAND - dense, brown						
1					SP-SM	Poorly Graded SAND with silt - dense, brown, decomposed Granodiorite						
	5					Backhoe Refusal Bottom of Test Pit @ 5 Feet						
2												
3	10											

IGES®

SAMPLE TYPE
- GRAB SAMPLE
- 3" O.D. THIN-WALLED HAND SAMPLER

WATER LEVEL
- MEASURED
- ESTIMATED

NOTES:

Plate

B - 25

DATE			
STARTED:	8/7/13	Geotechnical Investigation CS Mining Milford, UT	IGES Rep: JFW
COMPLETED:	8/7/13		Rig Type: Backhoe
BACKFILLED:	8/7/13	Project Number 01640-003	

TEST PIT NO: **TP-41**

Sheet 1 of 1

LOCATION

NORTHING 4,261,129 EASTING 315,366 ELEVATION

DEPTH METERS	DEPTH FEET	SAMPLES	WATER LEVEL	GRAPHICAL LOG	UNIFIED SOIL CLASSIFICATION	MATERIAL DESCRIPTION	Dry Density(pcf)	Moisture Content %	Percent minus 200	Liquid Limit	Plasticity Index	Moisture Content and Atterberg Limits (Plastic Limit, Moisture Content, Liquid Limit) 10 20 30 40 50 60 70 80 90
0	0				SM	Silty SAND - dense, brown						
1					SM	Silty SAND - dense, brown, decomposed Granodiorite						
	5							7	24			●
						Backhoe Refusal						
2						Bottom of Test Pit @ 6 Feet						
3	10											

LOG OF TEST PITS (A) SIMPLIFIED 01640-003.GPJ IGES.GDT 2/3/14

IGES®

SAMPLE TYPE
- GRAB SAMPLE
- 3" O.D. THIN-WALLED HAND SAMPLER

WATER LEVEL
- ▼- MEASURED
- ▽- ESTIMATED

NOTES:

Plate

B - 26

DATE		
STARTED:	8/7/13	
COMPLETED:	8/7/13	
BACKFILLED:	8/7/13	

Geotechnical Investigation
CS Mining
Milford, UT

Project Number 01640-003

IGES Rep: JFW

Rig Type: Backhoe

TEST PIT NO: **TP-42**

Sheet 1 of 1

LOCATION

NORTHING 4,261,146 EASTING 315,409 ELEVATION

DEPTH METERS	DEPTH FEET	SAMPLES	WATER LEVEL	GRAPHICAL LOG	UNIFIED SOIL CLASSIFICATION	MATERIAL DESCRIPTION	Dry Density(pcf)	Moisture Content %	Percent minus 200	Liquid Limit	Plasticity Index	Moisture Content and Atterberg Limits (Plastic Limit, Moisture Content, Liquid Limit; 10 20 30 40 50 60 70 80 90)
0	0				SM	Silty SAND with gravel - dense, brown						
								2	13			
1												
	5				SW-SM	Well Graded SAND with silt - dense, brown, decomposed Granodiorite						
								2	7			
2												
						Cobbles and Boulders - Canyon wash						
						Backhoe Refusal						
						Bottom of Test Pit @ 8.5 Feet						
3	10											

IGES®

SAMPLE TYPE
- GRAB SAMPLE
- 3" O.D. THIN-WALLED HAND SAMPLER

WATER LEVEL
- ▼ - MEASURED
- ▽ - ESTIMATED

NOTES:

Pla[redacted]

B - 27

DATE		Geotechnical Investigation CS Mining Milford, UT Project Number 01640-003	IGES Rep: JFW Rig Type: Backhoe	TEST PIT NO: TP-43 Sheet 1 of 1
STARTED:	8/7/13			
COMPLETED:	8/7/13			
BACKFILLED:	8/7/13			

LOCATION

NORTHING 4,261,176 EASTING 315,388 ELEVATION

DEPTH METERS	DEPTH FEET	SAMPLES	WATER LEVEL	GRAPHICAL LOG	UNIFIED SOIL CLASSIFICATION	MATERIAL DESCRIPTION	Dry Density(pcf)	Moisture Content %	Percent minus 200	Liquid Limit	Plasticity Index
0	0				SM	Silty SAND with gravel - dense, brown, roots to 8 - 12"					
		Grab						2	15		
1					SP-SM	Poorly Graded SAND with silt and cobbles - dense, brown, decomposed Granodiorite					
	5										
2		Grab						3	17		
						Backhoe Refusal Bottom of Test Pit @ 9 Feet					
3	10										

Moisture Content and Atterberg Limits

Plastic Limit — Moisture Content — Liquid Limit

10 20 30 40 50 60 70 80 90

IGES®

SAMPLE TYPE
- GRAB SAMPLE
- 3" O.D. THIN-WALLED HAND SAMPLER

WATER LEVEL
- ▼- MEASURED
- ▽- ESTIMATED

NOTES:

Plate

B - 28

DATE	
STARTED:	8/7/13
COMPLETED:	8/7/13
BACKFILLED:	8/7/13

Geotechnical Investigation
CS Mining
Milford, UT

Project Number 01640-003

IGES Rep: JFW

Rig Type: Backhoe

TEST PIT NO:

TP-44

Sheet 1 of

LOCATION

NORTHING 4,261,288 EASTING 315,295 ELEVATION

DEPTH METERS	DEPTH FEET	SAMPLES	WATER LEVEL	GRAPHICAL LOG	UNIFIED SOIL CLASSIFICATION	MATERIAL DESCRIPTION	Dry Density(pcf)	Moisture Content %	Percent minus 200	Liquid Limit	Plasticity Index	Moisture Content and Atterberg Limits (Plastic Limit / Moisture Content / Liquid Limit; 10 20 30 40 50 60 70 80 90)
0	0				SW-SM	Well Graded SAND with silt with gravel - dense, brown, roots to 6 - 12"						
								2	8			
1					SW-SM	Well Graded SAND - dense, brown, decomposed Granodiorite, friable						
	5							4	10			
						Backhoe Refusal						
2						Bottom of Test Pit @ 6 Feet						
3	10											

IGES®

SAMPLE TYPE
- GRAB SAMPLE
- 3" O.D. THIN-WALLED HAND SAMPLER

WATER LEVEL
- ▼- MEASURED
- ▽- ESTIMATED

NOTES:

Pla

B - 29

DATE	
STARTED:	8/7/13
COMPLETED:	8/7/13
BACKFILLED:	8/7/13

Geotechnical Investigation
CS Mining
Milford, UT
Project Number 01640-003

IGES Rep: JFW
Rig Type: Backhoe

TEST PIT NO:
TP-45
Sheet 1 of 1

LOCATION
NORTHING 4,261,198 EASTING 315,330 ELEVATION

DEPTH METERS	DEPTH FEET	SAMPLES	WATER LEVEL	GRAPHICAL LOG	UNIFIED SOIL CLASSIFICATION	MATERIAL DESCRIPTION	Dry Density(pcf)	Moisture Content %	Percent minus 200	Liquid Limit	Plasticity Index	Moisture Content and Atterberg Limits (Plastic Limit, Moisture Content, Liquid Limit) 10 20 30 40 50 60 70 80 90
0	0				SM	Silty SAND with gravel - dense, brown						
					SP-SM	Poorly Graded SAND with silt - dense, brown, decomposed Granodiorite						
						Backhoe Refusal						
						Bottom of Test Pit @ 3 Feet						
1												
	5											
2												
3	10											

IGES®

SAMPLE TYPE
- GRAB SAMPLE
- 3" O.D. THIN-WALLED HAND SAMPLER

WATER LEVEL
- MEASURED
- ESTIMATED

NOTES:

Plate
B - 30

DATE		
STARTED:	8/7/13	
COMPLETED:	8/7/13	
BACKFILLED:	8/7/13	

Geotechnical Investigation
CS Mining
Milford, UT
Project Number 01640-003

IGES Rep: JFW
Rig Type: Backhoe

TEST PIT NO:
TP-46
Sheet 1 of 1

LOCATION
NORTHING 4,261,198 EASTING 315,312 ELEVATION

DEPTH METERS	DEPTH FEET	SAMPLES	WATER LEVEL	GRAPHICAL LOG	UNIFIED SOIL CLASSIFICATION	MATERIAL DESCRIPTION	Dry Density(pcf)	Moisture Content %	Percent minus 200	Liquid Limit	Plasticity Index	Moisture Content and Atterberg Limits (Plastic Limit, Moisture Content, Liquid Limit) 10 20 30 40 50 60 70 80 90
0	0				SM	Silty SAND with gravel - dense, brown, roots to 4 - 6"						
					ML	Sandy SILT - stiff, tan, calcareous, decomposed rock						
1								18	51			
	5					Backhoe Refusal Bottom of Test Pit @ 5 Feet						
2												
3	10											

IGES®

SAMPLE TYPE
- GRAB SAMPLE
- 3" O.D. THIN-WALLED HAND SAMPLER

WATER LEVEL
- MEASURED
- ESTIMATED

NOTES:

Pla[redacted]
B - 31

DATE		Geotechnical Investigation CS Mining Milford, UT Project Number 01640-003	IGES Rep: JFW Rig Type: Backhoe	TEST PIT NO: TP-47 Sheet 1 of 1
	STARTED: 8/7/13			
	COMPLETED: 8/7/13			
	BACKFILLED: 8/7/13			

LOCATION

NORTHING 4,261,205 EASTING 315,273 ELEVATION

DEPTH METERS	DEPTH FEET	SAMPLES	WATER LEVEL	GRAPHICAL LOG	UNIFIED SOIL CLASSIFICATION	MATERIAL DESCRIPTION	Dry Density(pcf)	Moisture Content %	Percent minus 200	Liquid Limit	Plasticity Index	Moisture Content and Atterberg Limits (Plastic Limit, Moisture Content, Liquid Limit) 10 20 30 40 50 60 70 80 90
0	0				SM	Silty SAND with gravel - dense brown, roots to 6"						
					SP-SM	Poorly Graded SAND with silt - dense, brown, decomposed Granodiorite						
1												
						Backhoe Refusal						
						Bottom of Test Pit @ 3.5 Feet						
	5											
2												
3	10											

IGES®

SAMPLE TYPE
- GRAB SAMPLE
- 3" O.D. THIN-WALLED HAND SAMPLER

WATER LEVEL
▼- MEASURED
▽- ESTIMATED

NOTES:

Plate

B - 32

DATE		Geotechnical Investigation CS Mining Milford, UT Project Number 01640-003	IGES Rep: JFW Rig Type: Backhoe	TEST PIT NO: TP-48 Sheet 1 of 1
STARTED: 8/7/13				
COMPLETED: 8/7/13				
BACKFILLED: 8/7/13				

LOCATION

NORTHING 4,261,035 EASTING 315,257 ELEVATION

DEPTH METERS	DEPTH FEET	SAMPLES	WATER LEVEL	GRAPHICAL LOG	UNIFIED SOIL CLASSIFICATION	MATERIAL DESCRIPTION	Dry Density(pcf)	Moisture Content %	Percent minus 200	Liquid Limit	Plasticity Index	Moisture Content and Atterberg Limits (Plastic Limit, Moisture Content, Liquid Limit) 10 20 30 40 50 60 70 80 90
0	0					Silty SAND						
						Bedrock at 6"						
						Bottom of Test Pit @ 0.5 Feet						
1												
	5											
2												
3	10											

IGES®

SAMPLE TYPE
- GRAB SAMPLE
- 3" O.D. THIN-WALLED HAND SAMPLER

WATER LEVEL
- MEASURED
- ESTIMATED

NOTES:

Plate

B - 33

DATE		Geotechnical Investigation CS Mining Milford, UT	IGES Rep: JFW	TEST PIT NO:
STARTED:	8/7/13			TP-49
COMPLETED:	8/7/13		Rig Type: Backhoe	
BACKFILLED:	8/7/13	Project Number 01640-003		Sheet 1 of 1

LOCATION

NORTHING 4,261,014 EASTING 315,244 ELEVATION

DEPTH METERS	DEPTH FEET	SAMPLES	WATER LEVEL	GRAPHICAL LOG	UNIFIED SOIL CLASSIFICATION	MATERIAL DESCRIPTION	Dry Density(pcf)	Moisture Content %	Percent minus 200	Liquid Limit	Plasticity Index	Moisture Content and Atterberg Limits (Plastic Limit, Moisture Content, Liquid Limit) 10 20 30 40 50 60 70 80 90
0	0				SM	Silty SAND with gravel - dense, brown, roots to 8"						
					SM	Silty SAND with some gravel - stiff, brown, fine to medium sand						
1	5							6	35			
2												
						Backhoe Refusal						
						Bottom of Test Pit @ 8.5 Feet						
3	10											

IGES®

SAMPLE TYPE
- GRAB SAMPLE
- 3" O.D. THIN-WALLED HAND SAMPLER

WATER LEVEL
- MEASURED
- ESTIMATED

NOTES:

Plate

B - 34

DATE		
STARTED:	8/7/13	
COMPLETED:	8/7/13	
BACKFILLED:	8/7/13	

Geotechnical Investigation
CS Mining
Milford, UT
Project Number 01640-003

IGES Rep: JFW
Rig Type: Backhoe

TEST PIT NO: **TP-50**
Sheet 1 of 1

LOCATION
NORTHING 4,261,052 EASTING 315,223 ELEVATION

DEPTH METERS	DEPTH FEET	SAMPLES	WATER LEVEL	GRAPHICAL LOG	UNIFIED SOIL CLASSIFICATION	MATERIAL DESCRIPTION	Dry Density(pcf)	Moisture Content %	Percent minus 200	Liquid Limit	Plasticity Index	Moisture Content and Atterberg Limits (Plastic Limit, Moisture Content, Liquid Limit) 10 20 30 40 50 60 70 80 90
0	0				SM	Silty SAND - dense, brown						
						Granodiorite - weathered Backhoe Refusal Bottom of Test Pit @ 2.5 Feet						
1												
	5											
2												
3	10											

LOG OF TEST PITS (A) SIMPLIFIED 01640-003.GPJ IGES.GDT 2/3/14

IGES®

SAMPLE TYPE
- GRAB SAMPLE
- 3" O.D. THIN-WALLED HAND SAMPLER

WATER LEVEL
▼- MEASURED
▽- ESTIMATED

NOTES:

Pla
B - 35

DATE		
STARTED:	8/7/13	
COMPLETED:	8/7/13	
BACKFILLED:	8/7/13	

Geotechnical Investigation
CS Mining
Milford, UT
Project Number 01640-003

IGES Rep: JFW
Rig Type: Backhoe

TEST PIT NO:
TP-51
Sheet 1 of 1

LOCATION
NORTHING 4,261,444 EASTING 315,217 ELEVATION

DEPTH METERS	DEPTH FEET	SAMPLES	WATER LEVEL	GRAPHICAL LOG	UNIFIED SOIL CLASSIFICATION	MATERIAL DESCRIPTION	Dry Density(pcf)	Moisture Content %	Percent minus 200	Liquid Limit	Plasticity Index
0	0				SW-SM	Well Graded SAND with silt - dense, brown, roots to 12 - 14"					
		Grab sample						2	6		
	5				SW-SM	Well Graded SAND with silt - dense, brown, weathered Granodiorite					
						Backhoe Refusal Bottom of Test Pit @ 5.5 Feet					
1											
2											
3	10										

Moisture Content and Atterberg Limits
Plastic Limit — Moisture Content — Liquid Limit
10 20 30 40 50 60 70 80 90

IGES®

SAMPLE TYPE
- GRAB SAMPLE
- 3" O.D. THIN-WALLED HAND SAMPLER

WATER LEVEL
- MEASURED
- ESTIMATED

NOTES:

Plate
B - 36

DATE	
STARTED:	8/7/13
COMPLETED:	8/7/13
BACKFILLED:	8/7/13

Geotechnical Investigation
CS Mining
Milford, UT
Project Number 01640-003

IGES Rep: JFW
Rig Type: Backhoe

TEST PIT NO:
TP-52
Sheet 1 of 1

LOCATION
NORTHING 4,261,463 EASTING 315,231 ELEVATION

DEPTH METERS	DEPTH FEET	SAMPLES	WATER LEVEL	GRAPHICAL LOG	UNIFIED SOIL CLASSIFICATION	MATERIAL DESCRIPTION	Dry Density(pcf)	Moisture Content %	Percent minus 200	Liquid Limit	Plasticity Index	Moisture Content and Atterberg Limits (Plastic Limit, Moisture Content, Liquid Limit) 10 20 30 40 50 60 70 80 90
0	0				SW-SM	Well Graded SAND with silt and gravel - dense, brown						
1		grab						3	9			
2	5											
						Bottom of Test Pit @ 7.5 Feet						
3	10											

IGES®

SAMPLE TYPE
- GRAB SAMPLE
- 3" O.D. THIN-WALLED HAND SAMPLER

WATER LEVEL
- MEASURED
- ESTIMATED

NOTES:

Plate
B - 37

DATE	
STARTED:	8/7/13
COMPLETED:	8/7/13
BACKFILLED:	8/7/13

Geotechnical Investigation
CS Mining
Milford, UT

Project Number 01640-003

IGES Rep: JFW

Rig Type: Backhoe

TEST PIT NO: **TP-53**

Sheet 1 of 1

LOCATION

NORTHING 4,261,534 EASTING 315,185 ELEVATION

MATERIAL DESCRIPTION

DEPTH (METERS)	DEPTH (FEET)	SAMPLES	WATER LEVEL	GRAPHICAL LOG	UNIFIED SOIL CLASSIFICATION	MATERIAL DESCRIPTION	Dry Density(pcf)	Moisture Content %	Percent minus 200	Liquid Limit	Plasticity Index
0	0				SM	Silty SAND with gravel					
1		Grab sample						3	16		
2	5										
3	10					Bottom of Test Pit @ 9 Feet					

Moisture Content and Atterberg Limits

Plastic Limit — Moisture Content — Liquid Limit

10 20 30 40 50 60 70 80 90

IGES®

SAMPLE TYPE
- GRAB SAMPLE
- 3" O.D. THIN-WALLED HAND SAMPLER

WATER LEVEL
- ▼- MEASURED
- ▽- ESTIMATED

NOTES:

Plate B - 38

DATE	
STARTED:	8/7/13
COMPLETED:	8/7/13
BACKFILLED:	8/7/13

Geotechnical Investigation
CS Mining
Milford, UT
Project Number 01640-003

IGES Rep: JFW
Rig Type: Backhoe

TEST PIT NO:
TP-54
Sheet 1 of 1

LOCATION

NORTHING | EASTING | ELEVATION

DEPTH METERS	DEPTH FEET	SAMPLES	WATER LEVEL	GRAPHICAL LOG	UNIFIED SOIL CLASSIFICATION	MATERIAL DESCRIPTION	Dry Density(pcf)	Moisture Content %	Percent minus 200	Liquid Limit	Plasticity Index
0	0				SM	Silty SAND with gravel - dense, brown					
						Bottom of Test Pit @ 7.5 Feet					

Depth scale: Meters 0, 1, 2, 3; Feet 0, 5, 10

Moisture Content and Atterberg Limits
Plastic Limit — Moisture Content — Liquid Limit
10 20 30 40 50 60 70 80 90

IGES®

SAMPLE TYPE
- GRAB SAMPLE
- 3" O.D. THIN-WALLED HAND SAMPLER

WATER LEVEL
▼ - MEASURED
▽ - ESTIMATED

NOTES:

Plate
B - 39

DATE	
STARTED:	8/7/13
COMPLETED:	8/7/13
BACKFILLED:	8/7/13

Geotechnical Investigation
CS Mining
Milford, UT
Project Number 01640-003

IGES Rep: JFW
Rig Type: Backhoe

TEST PIT NO:
TP-55
Sheet 1 of 1

LOCATION
NORTHING 4,261,836 EASTING 315,040 ELEVATION

DEPTH METERS	DEPTH FEET	SAMPLES	WATER LEVEL	GRAPHICAL LOG	UNIFIED SOIL CLASSIFICATION	MATERIAL DESCRIPTION	Dry Density(pcf)	Moisture Content %	Percent minus 200	Liquid Limit	Plasticity Index	Moisture Content and Atterberg Limits (Plastic Limit, Moisture Content, Liquid Limit; 10 20 30 40 50 60 70 80 90)
0	0				SW-SM	Well Graded SAND with silt and gravel - dense, brown, with cobble layers						
1												
	5							2	9			
2												
						Bottom of Test Pit @ 7.5 Feet						
3	10											

LOG OF TEST PITS (A) SIMPLIFIED 01640-003.GPJ IGES.GDT 2/3/14

IGES®

SAMPLE TYPE
- GRAB SAMPLE
- 3" O.D. THIN-WALLED HAND SAMPLER

WATER LEVEL
- MEASURED
- ESTIMATED

NOTES:

Plate B - 40

UNIFIED SOIL CLASSIFICATION SYSTEM

MAJOR DIVISIONS			USCS SYMBOL	TYPICAL DESCRIPTIONS
COARSE GRAINED SOILS (More than half of material is larger than the #200 sieve)	GRAVELS (More than half of coarse fraction is larger than the #4 sieve)	CLEAN GRAVELS WITH LITTLE OR NO FINES	GW	WELL-GRADED GRAVELS, GRAVEL-SAND MIXTURES WITH LITTLE OR NO FINES
			GP	POORLY-GRADED GRAVELS, GRAVEL-SAND MIXTURES WITH LITTLE OR NO FINES
		GRAVELS WITH OVER 12% FINES	GM	SILTY GRAVELS, GRAVEL-SILT-SAND MIXTURES
			GC	CLAYEY GRAVELS, GRAVEL-SAND-CLAY MIXTURES
	SANDS (More than half of coarse fraction is smaller than the #4 sieve)	CLEAN SANDS WITH LITTLE OR NO FINES	SW	WELL-GRADED SANDS, SAND-GRAVEL MIXTURES WITH LITTLE OR NO FINES
			SP	POORLY-GRADED SANDS, SAND-GRAVEL MIXTURES WITH LITTLE OR NO FINES
		SANDS WITH OVER 12% FINES	SM	SILTY SANDS, SAND-GRAVEL-SILT MIXTURES
			SC	CLAYEY SANDS SAND-GRAVEL-CLAY MIXTURES
FINE GRAINED SOILS (More than half of material is smaller than the #200 sieve)	SILTS AND CLAYS (Liquid limit less than 50)		ML	INORGANIC SILTS & VERY FINE SANDS, SILTY OR CLAYEY FINE SANDS, CLAYEY SILTS WITH SLIGHT PLASTICITY
			CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
			OL	ORGANIC SILTS & ORGANIC SILTY CLAYS OF LOW PLASTICITY
	SILTS AND CLAYS (Liquid limit greater than 50)		MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SAND OR SILT
			CH	INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS
			OH	ORGANIC CLAYS & ORGANIC SILTS OF MEDIUM-TO-HIGH PLASTICITY
HIGHLY ORGANIC SOILS			PT	PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENTS

LOG KEY SYMBOLS

BORING SAMPLE LOCATION

TEST-PIT SAMPLE LOCATION

WATER LEVEL (level after completion)

WATER LEVEL (level where first encountered)

CEMENTATION

DESCRIPTION	DESCRIPTION
WEAKELY	CRUMBLES OR BREAKS WITH HANDLING OR SLIGHT FINGER PRESSURE
MODERATELY	CRUMBLES OR BREAKS WITH CONSIDERABLE FINGER PRESSURE
STRONGLY	WILL NOT CRUMBLE OR BREAK WITH FINGER PRESSURE

OTHER TESTS KEY

C	CONSOLIDATION	SA	SIEVE ANALYSIS
AL	ATTERBURG LIMITS	DS	DIRECT SHEAR
UC	UNCONFINED COMPRESSION	T	TRIAXIAL
S	SOLUBILITY	R	RESISTIVITY
O	ORGANIC CONTENT	RV	R-VALUE
CBR	CALIFORNIA BEARING RATIO	SU	SOLUBLE SULFATES
COMP	MOISTURE/DENSITY RELATIONSHIP	PM	PERMEABILITY
CI	CALIFORNIA IMPACT	-200	% FINER THAN #200
COL	COLLAPSE POTENTIAL	Gs	SPECIFIC GRAVITY
SS	SHRINK SWELL	SL	SWELL LOAD

MODIFIERS

DESCRIPTION	%
TRACE	<5
SOME	5 - 12
WITH	>12

MOISTURE CONTENT

DESCRIPTION	FIELD TEST
DRY	ABSENCE OF MOISTURE, DUSTY, DRY TO THE TOUCH
MOIST	DAMP BUT NO VISIBLE WATER
WET	VISIBLE FREE WATER, USUALLY SOIL BELOW WATER TABLE

STRATIFICATION

DESCRIPTION	THICKNESS	DESCRIPTION	THICKNESS
SEAM	1/16 - 1/2"	OCCASIONAL	ONE OR LESS PER FOOT OF THICKNESS
LAYER	1/2 - 12"	FREQUENT	MORE THAN ONE PER FOOT OF THICKNESS

GENERAL NOTES

1. Lines separating strata on the logs represent approximate boundaries only. Actual transitions may be gradual.
2. No warranty is provided as to the continuity of soil conditions between individual sample locations.
3. Logs represent general soil conditions observed at the point of exploration on the date indicated.
4. In general, Unified Soil Classification designations presented on the logs were evaluated by visual methods only. Therefore, actual designations (based on laboratory tests) may vary.

APPARENT / RELATIVE DENSITY - COARSE-GRAINED SOIL

APPARENT DENSITY	SPT (blows/ft)	MODIFIED CA. SAMPLER (blows/ft)	CALIFORNIA SAMPLER (blows/ft)	RELATIVE DENSITY (%)	FIELD TEST
VERY LOOSE	<4	<4	<5	0 - 15	EASILY PENETRATED WITH 1/2-INCH REINFORCING ROD PUSHED BY HAND
LOOSE	4 - 10	5 - 12	5 - 15	15 - 35	DIFFICULT TO PENETRATE WITH 1/2-INCH REINFORCING ROD PUSHED BY HAND
MEDIUM DENSE	10 - 30	12 - 35	15 - 40	35 - 65	EASILY PENETRATED A FOOT WITH 1/2-INCH REINFORCING ROD DRIVEN WITH 5-LB HAMMER
DENSE	30 - 50	35 - 60	40 - 70	65 - 85	DIFFICULT TO PENETRATED A FOOT WITH 1/2-INCH REINFORCING ROD DRIVEN WITH 5-LB HAMMER
VERY DENSE	>50	>60	>70	85 - 100	PENETRATED ONLY A FEW INCHES WITH 1/2-INCH REINFORCING ROD DRIVEN WITH 5-LB HAMMER

CONSISTENCY - FINE-GRAINED SOIL

CONSISTENCY	SPT (blows/ft)	TORVANE UNTRAINED SHEAR STRENGTH (tsf)	POCKET PENETROMETER UNCONFINED COMPRESSIVE STRENGTH (tsf)	FIELD TEST
VERY SOFT	<2	<0.125	<0.25	EASILY PENETRATED SEVERAL INCHES BY THUMB. EXUDES BETWEEN THUMB AND FINGERS WHEN SQUEEZED BY HAND.
SOFT	2 - 4	0.125 - 0.25	0.25 - 0.5	EASILY PENETRATED ONE INCH BY THUMB. MOLDED BY LIGHT FINGER PRESSURE.
MEDIUM STIFF	4 - 8	0.25 - 0.5	0.5 - 1.0	PENETRATED OVER 1/2 INCH BY THUMB WITH MODERATE EFFORT. MOLDED BY STRONG FINGER PRESSURE.
STIFF	8 - 15	0.5 - 1.0	1.0 - 2.0	INDENTED ABOUT 1/2 INCH BY THUMB BUT PENETRATED ONLY WITH GREAT EFFORT.
VERY STIFF	15 - 30	1.0 - 2.0	2.0 - 4.0	READILY INDENTED BY THUMBNAIL.
HARD	>30	>2.0	>4.0	INDENTED WITH DIFFICULTY BY THUMBNAIL.

IGES

KEY TO SOIL SYMBOLS AND TERMINOLOGY

Plate B-41

Project Number 01640-002

TYPICAL ROCK DESCRIPTION AND GRAPHICAL SYMBOLS

	CONGLOMERATE
	SANDSTONE
	SILTSTONE
	SHALE
	LIMESTONE
	DOLOMITE
	GYPSUM
	METAMORPHIC
	IGNEOUS
	GENERAL BEDROCK

LOG KEY SYMBOLS

BORING OR CORE SAMPLE LOCATION

TEST-PIT SAMPLE LOCATION

WATER LEVEL (level after completion)

WATER LEVEL (level where first encountered)

OTHER TESTS KEY

C	CONSOLIDATION	SA	SIEVE ANALYSIS
AL	ATTERBURG LIMITS	DS	DIRECT SHEAR
UC	UNCONFINED COMPRESSION	T	TRIAXIAL
S	SOLUBILITY	R	RESISTIVITY
O	ORGANIC CONTENT	RV	R-VALUE
CBR	CALIFORNIA BEARING RATIO	SU	SOLUBLE SULFATES
COMP	MOISTURE/DENSITY RELATIONSHIP	PM	PERMEABILITY
CI	CALIFORNIA IMPACT	-200	% FINER THAN #200
COL	COLLAPSE POTENTIAL	Gs	SPECIFIC GRAVITY
SS	SHRINK SWELL	SL	SWELL LOAD
P	POINT LOAD		

FRACTURING

SPACING	DESCRIPTION
>6 FT	VERY WIDELY
2-6 FT	WIDELY
8-24 IN	MODERATELY
2 1/2 -8 IN	CLOSELY
3/4 - 2 1/2 IN	VERY CLOSELY

WEATHERING

WEATHERING	FIELD TEST
FRESH	NO VISIBLE SIGN OF DECOMPOSITION OR DISCOLORATION. RINGS UNDER HAMMER IMPACT.
SLIGHTLY WEATHERED	SLIGHT DISCOLORATION INWARDS FROM OPEN FRACTURES, OTHERWISE SIMILAR TO FRESH.
MODERATELY WEATHERED	DISCOLORATION THROUGHOUT. WEAKER MINERALS SUCH AS FELDSPAR ARE DECOMPOSED. STRENGTH SOMEWHAT LESS THAN FRESH ROCK BUT CORES CANNOT BE BROKEN BY HAND OR SCRAPED WITH A KNIFE.
HIGHLY WEATHERED	MOST MINERALS SOMEWHAT DECOMPOSED. SPECIMENS CAN BE BROKEN BY HAND WITH EFFORT OR SHAVED WITH A KNIFE. TEXTURE PRESERVED.
COMPLETELY WEATHERED	MINERALS DECOMPOSED TO SOIL BUT FABRIC AND STRUCTURE PRESERVED. SPECIMENS EASILY CRUMBLE OR PENETRATED.

RQD

RQD (%)	ROCK QUALITY
90-100	EXCELLENT
75-90	GOOD
50-75	FAIR
25-50	POOR
0-25	VERY POOR

COMPETENCY

CLASS	STRENGTH	FIELD TEST	APPROXIMATE RANGE OF UNCONFINED COMPRESSIVE STRENGTH (TSF)
I	EXTREMELY STRONG	MANY BLOWS WITH GEOLOGIC HAMMER REQUIRED TO BREAK INTACT SPECIMEN.	>2000
II	VERY STRONG	HAND-HELD SPECIMEN BREAKS WITH PICK END OF HAMMER UNDER MORE THAN ONE BLOW.	2000-1000
III	STRONG	CANNOT BE SCRAPED OR PEELED WITH KNIFE, HAND-HELD SPECIMEN CAN BE BROKEN WITH SINGLE MODERATE BLOW WITH PICK END OF HAMMER	1000-500
IV	MODERATELY STRONG	CAN JUST BE SCRAPED OR PEELED WITH KNIFE. INDENTATIONS 1-3 mm SHOW IN SPECIMEN WITH MODERATE BLOW WITH PICK END OF HAMMER	500-250
V	WEAK	MATERIAL CRUMBLES UNDER MODERATE BLOW WITH PICK END OF HAMMER AND CAN BE PEELED WITH KNIFE, BUT IS HARD TO HAND-TRIM FOR TRIAXIAL TEST SPECIMEN.	250-10
VI	FRIABLE	MATERIAL CRUMBLES IN HAND.	N/A

BEDDING OF SEDIMENTARY ROCKS

SPLITTING PROPERTY	THICKNESS	STRATIFICATION
MASSIVE	>4.0 FT	VERY THICK BEDDED
BLOCKY	2.0-4.0 FT	THICK-BEDDED
SLABBY	2 1/2-24 IN	THIN-BEDDED
FLAGGY	1/2-2 1/2 IN	VERY THIN-BEDDED
SHALY OR PLATY	1/8-1/2 IN	LAMINATED
PAPERY	<1/8 IN	THINLY LAMINATED

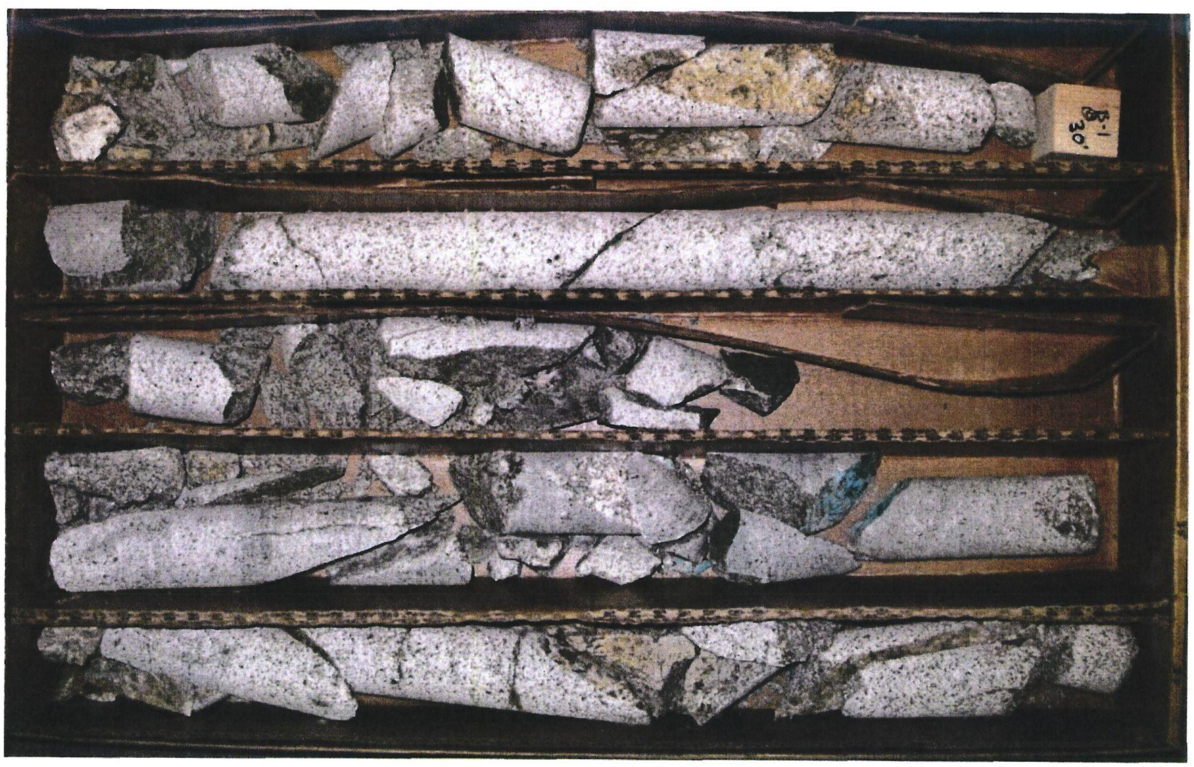
IGES

KEY TO PHYSICAL ROCK PROPERTIES

Project Number 01640-002

Plate **B-42**

Borings B-1 - 5' to 35'



Boring B-1 – 35' to 39'1"

Project Number – 01640-002

Rock Core
Photographs

Geotechnical Investigation
CS Mining
Plant Expansion
Beaver County, Utah

PLATE

B-43

Borings B-1 – 39' 1" to 49' 7.5"

Boring B-2 – 5' to 15'

IGES®

Project Number – 01640-002

Rock Core
Photographs

Geotechnical Investigation
CS Mining
Plant Expansion
Beaver County, Utah

PLATE
B-44

Borings B-2 – 15' to 35'

Boring B-2 – 35' to 50'

Borings B-3 – 15' to 34'6"

SAGE EARTH SCIENCE
GEOPHYSICAL SURVEYS

September 1, 2013

RE: SEISMIC REFRACTION SURVEY – DEPTH TO ROCK/RIPPABILITY – CS MINING TAILING POND

Based on the project objective and site conditions, Sage Earth Science conducted a seismic refraction tomography survey to map the depth to rock and determine overburden and refractor velocity at the Southern Utah site.

P-wave survey (refraction)
Given a physical setting of increasing density with depth, and by measuring the travel time of a compression wave (*p-wave*) between known points, the seismic refraction method can be used to determine the depth to a refracting horizon(s), the seismic velocity of the refracting horizon(s), as well as thickness and velocities of the overlying materials.

Figure 1. field equipment

Approximately 2,150 feet p-wave refraction profile were acquired. Profiles were located at the site as directed by the customer. Data were acquired in accordance with ASTM standard, **ASTM D 5777-00** *Standard Guide for Using the Seismic Refraction Method for Subsurface Investigation.* Data were reduced using PlotRefra™ seismic refraction tomographic inversion software produced by Geometrics Inc.

Sage Earth Science used a 24-channel engineering seismograph and 16 lb. sledgehammer to perform the acoustic travel time measurements. Data are collected in 150 foot arrays with 24 geophones, one placed every 6.56 feet along profile. Nine records for each 24 channel array were obtained.

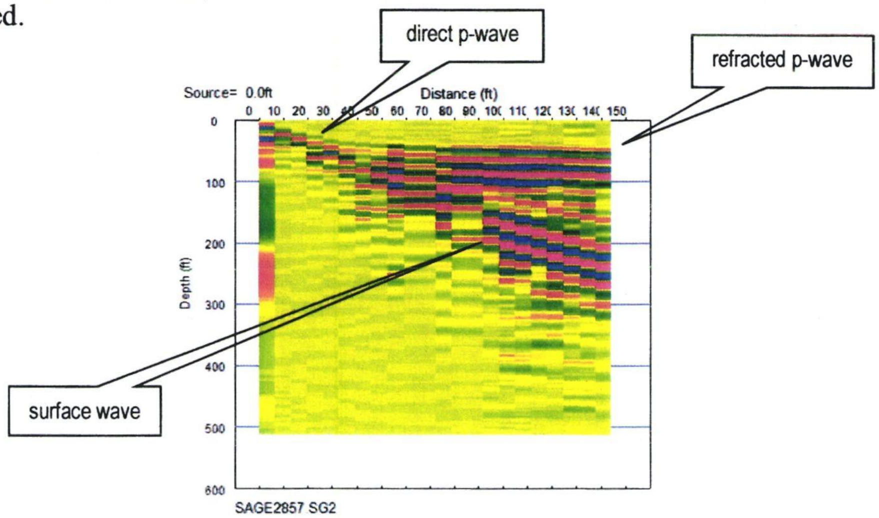


Figure #2 Typical field record

2184 Channing Way, Suite 110, Idaho Falls, ID 83404
telephone: (208)522-5049, Fax: (208)528-6200, email: sageearthscience@yahoo.com
http://www.sageearthscience.com

Table 1 Seismic Survey recording parameters

recording instrument	Bison 9024 s/n 6-93913
geophone	Mark products – 4.5 hz. vertical
Geophone/station spacing	6.56 feet (2 meters)
number of channels	24
spread length	150 feet
sample rate	0.25 millisecond
number of samples/channel	1,000
record length	0.25 seconds
low pass filter	120 Hz.
low cut filter	4 Hz.
seismic source	16 pound sledge hammer
source locations	Channels 1,4,7,10,13,16,19,22,24
P-wave refraction	Tomographic inversion PlotRefra™

Profile locations were field located as directed by the customer. Approximate locations are shown in figure 3. Elevation data were provided by IGES.

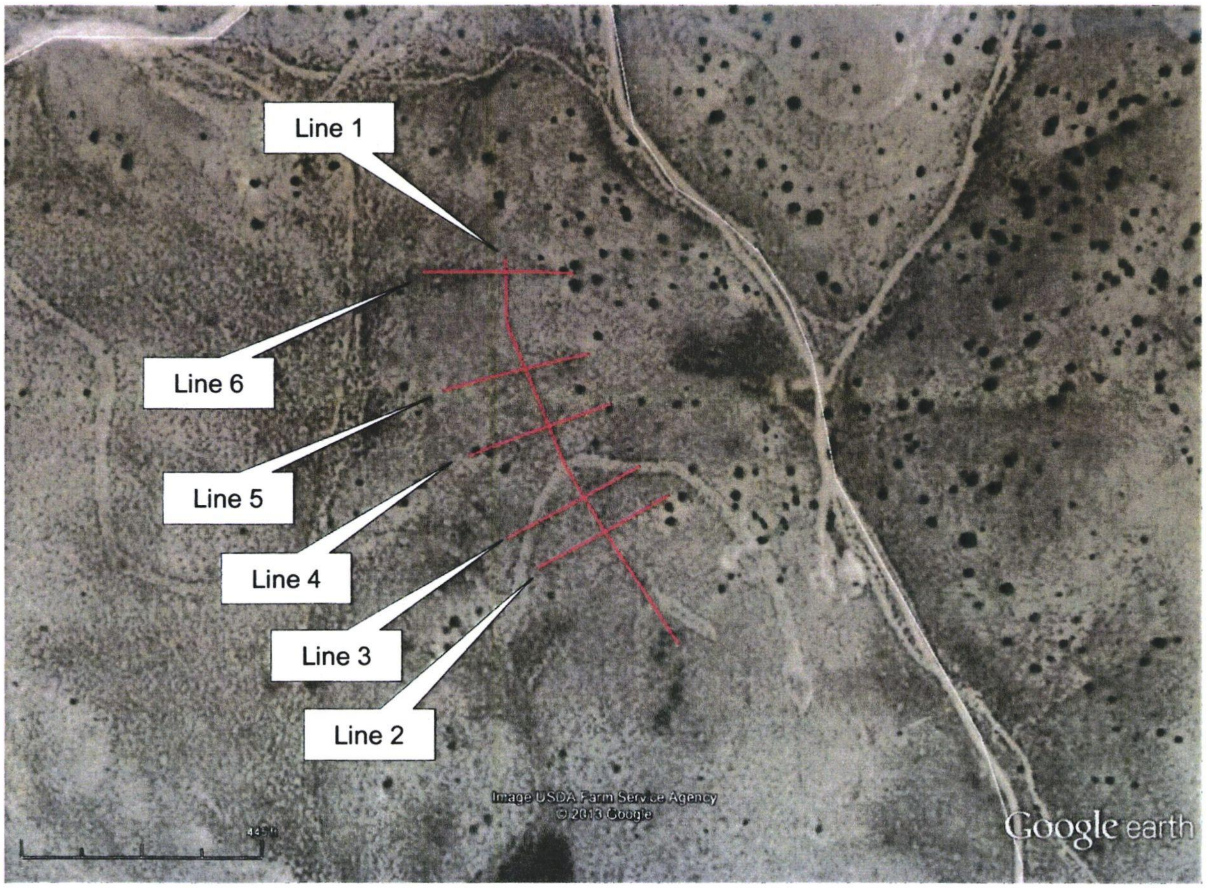


Figure 3. Profile locations. *(scale and locations approximate)*

Discussion
The following figures show the compression wave velocity profiles at the locations show in figure 3. The site is characterized by three general velocity zones.

The first velocity zone is a low velocity material exhibiting a velocity below 2,500 feet per second. This material is a low density sediment or unconsolidated weathered material. These materials are shown as blue-green in the profile figures.

A mid-range velocity zone 2,500 fps - 5,000 fps is likely a weathered or highly fractured rock material. These materials are shown as yellow-orange in the profile figures.

Red-maroon in the profile figures should be considered rock material. Based on the relatively low seismic velocity, the rock appears to be relatively low density fractured rock.

The velocities observed across the site are generally low. According to the Caterpillar Handbook for Ripping, seismic velocities are but one aspect of a rippablity survey and should be used in conjunction with other tests, observations, and experience.

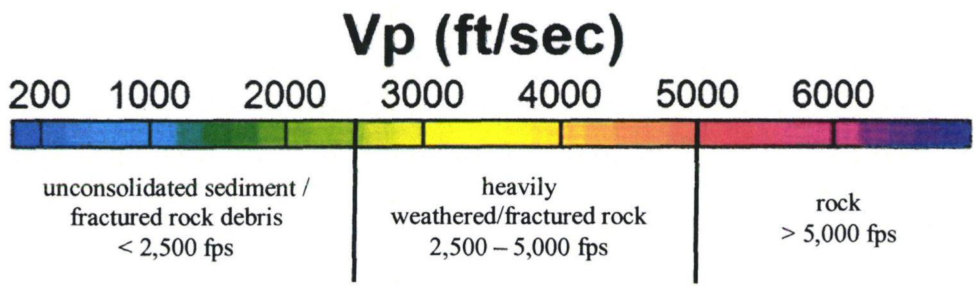


Figure #4 General velocity range of materials

Distances and depths are measured in feet. Velocities are reported in feet per second. Profile distances is the distance south or east within each profile depending on the profile orientation.

As a general guide, quoting from the ASTM standard, **ASTM D 5777-00** *Standard Guide for Using the Seismic Refraction Method for Subsurface Investigation*

> *The seismic refraction method provides the velocity of compressional P-waves in subsurface materials. Although the P-wave velocity can be a good indicator of the type of soil or rock, it is not a unique indicator. Table 2 shows that each type of sediment or rock has a wide range of seismic velocities, and many of these ranges significantly overlap. While the seismic refraction technique measures the seismic velocity of seismic waves in earth materials, it is the interpreter who based on*

knowledge of the local conditions or other data, or both, must interpret the seismic refraction data and arrive at a geologically reasonable solution

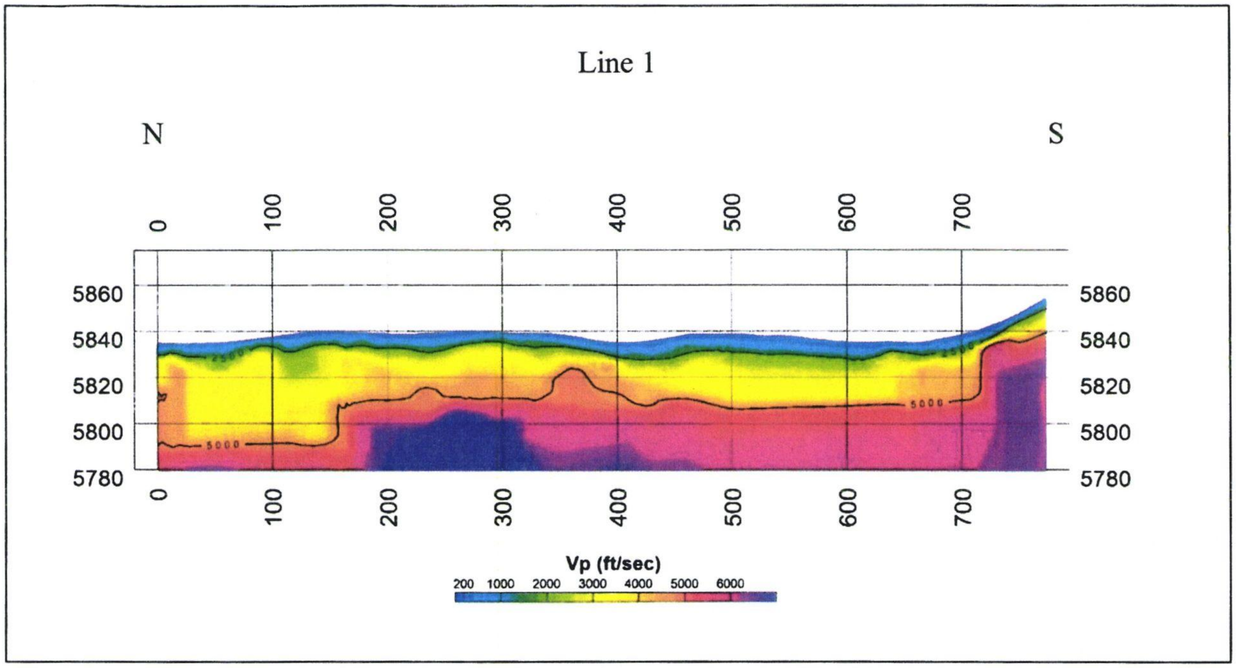
Table 2

Material	***wave velocity Vp feet/second***	***wave velocity Vp meters/second***
Weathered surface material	*800-2,000*	*250-600*
Gravel or dry sand	*1,500-3,000*	*460-900*
Sand (saturated)	*4,000-6,000*	*1,200-1,800*
Clay (saturated)	*3,000-9,000*	*900-2,700*
Sandstone	*6,000-13,000*	*1,800-4,000*
Shale	*9,000-14,000*	*2,700-4,300*
Chalk	*6,000-13,000*	*1,800-4,000*
Limestone	*7,000-20,000*	*2,100-6,100*
Granite	*15,000-19,000*	*4,600-5,800*
Metamorphic rock	*10,000-23,000*	*3,000-7,000*

5.2.2. According to Mooney (8), P-wave velocities are generally greater for:

1. *Denser rocks than lighter rocks*
2. *Older rocks than younger rocks*
3. *Igneous rocks than sedimentary rocks*
4. *Solid rocks than rocks with crack and fractures*
5. *Unweathered rocks than weathered rocks*
6. *Consolidated sediments than unconsolidated sediments*
7. *Water saturated rocks/sediments than unsaturated rocks/sediments*
8. *Wet soils than dry soils*

Glen Carpenter / principal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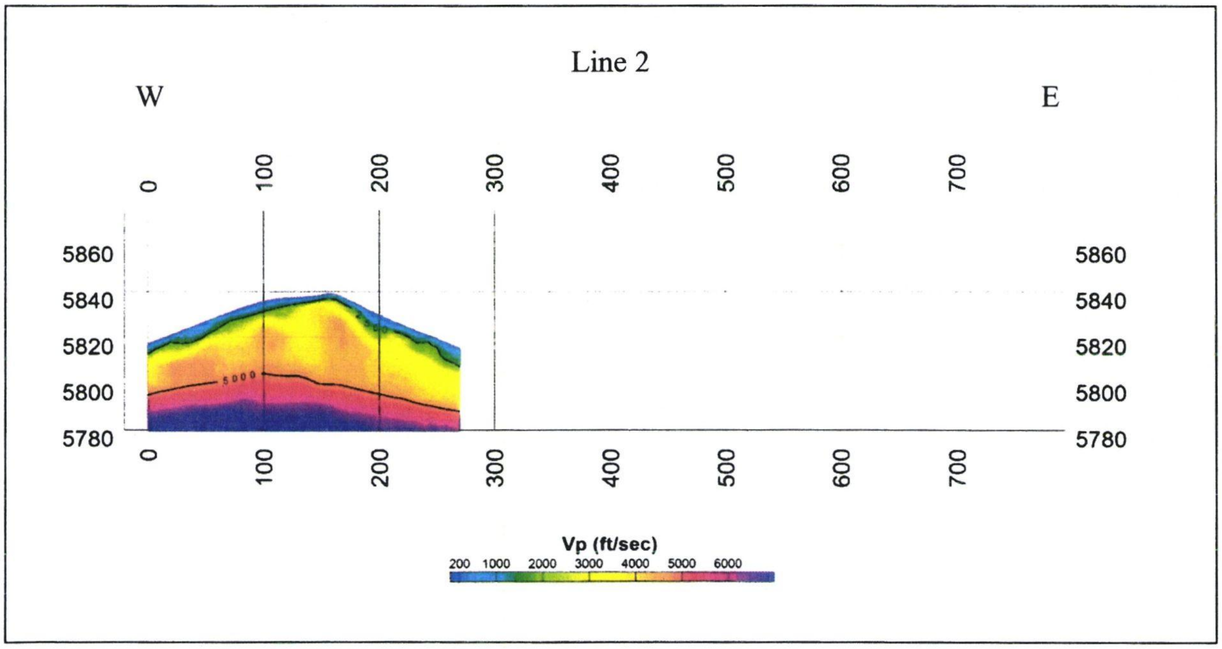
Vp (ft/sec)
200 1000 2000 3000 4000 5000 6000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Vp (ft/sec)
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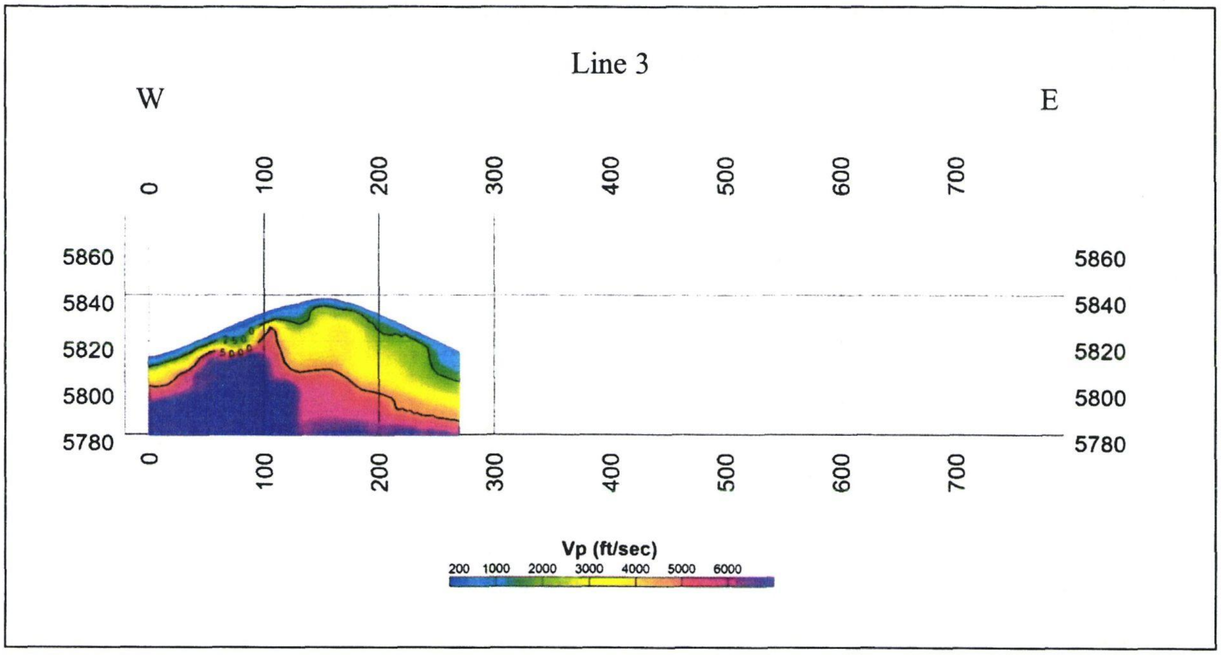
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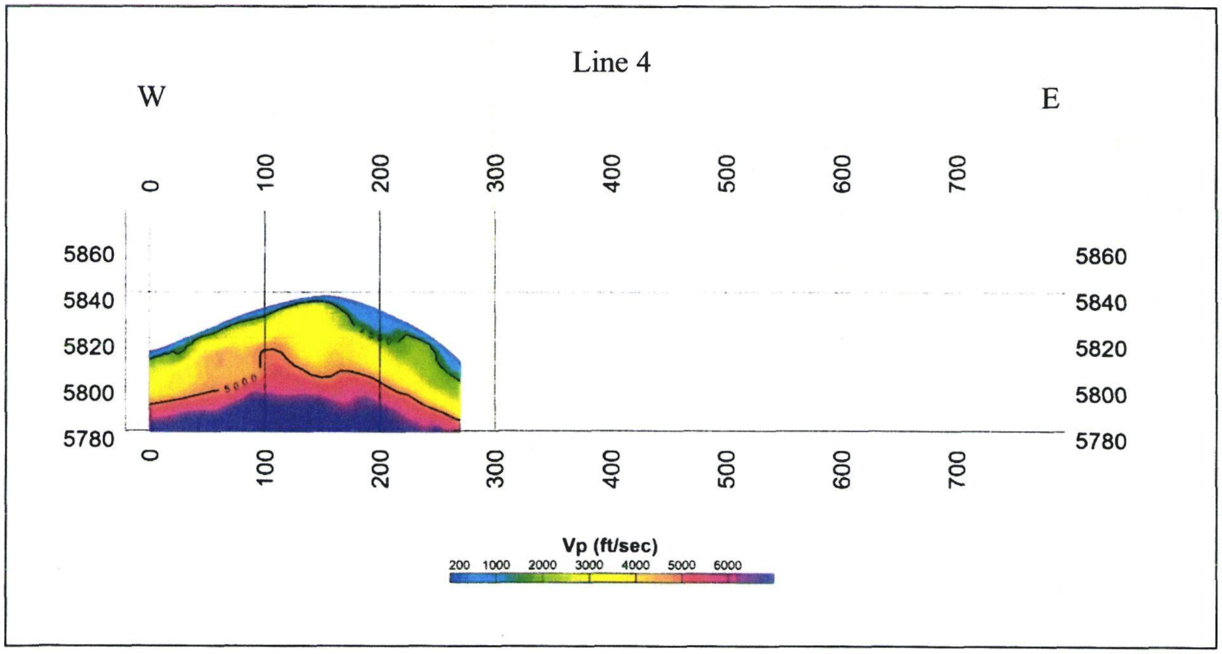
Vp (ft/sec)
200 1000 2000 3000 4000 5000 6000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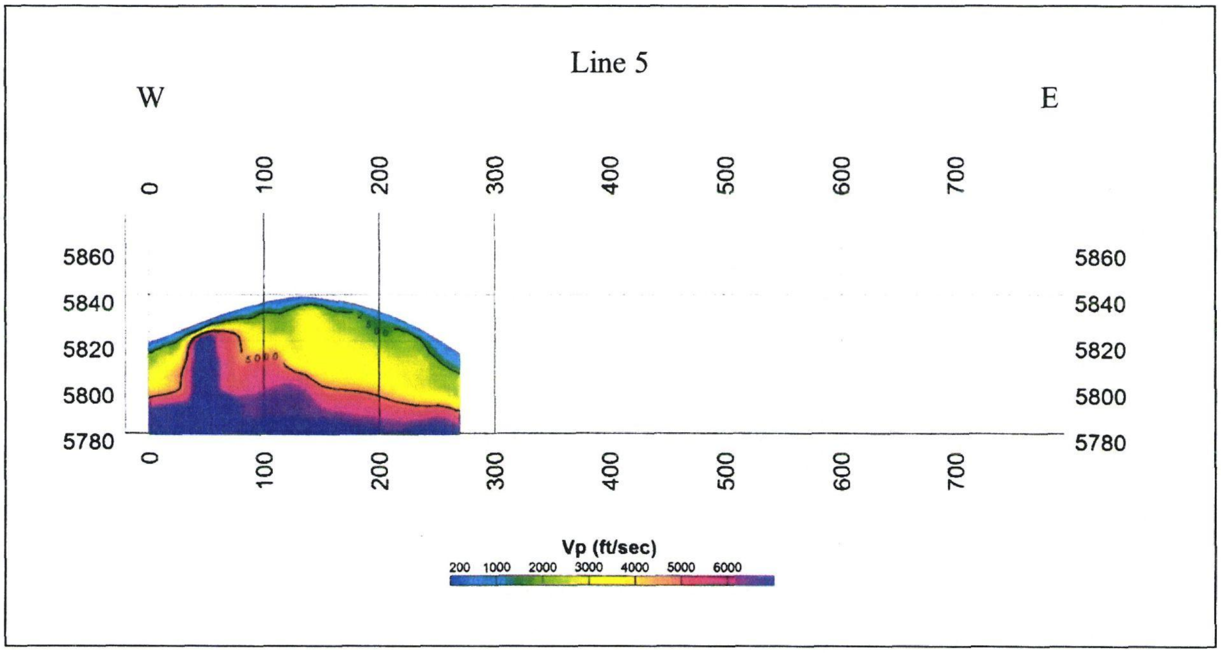

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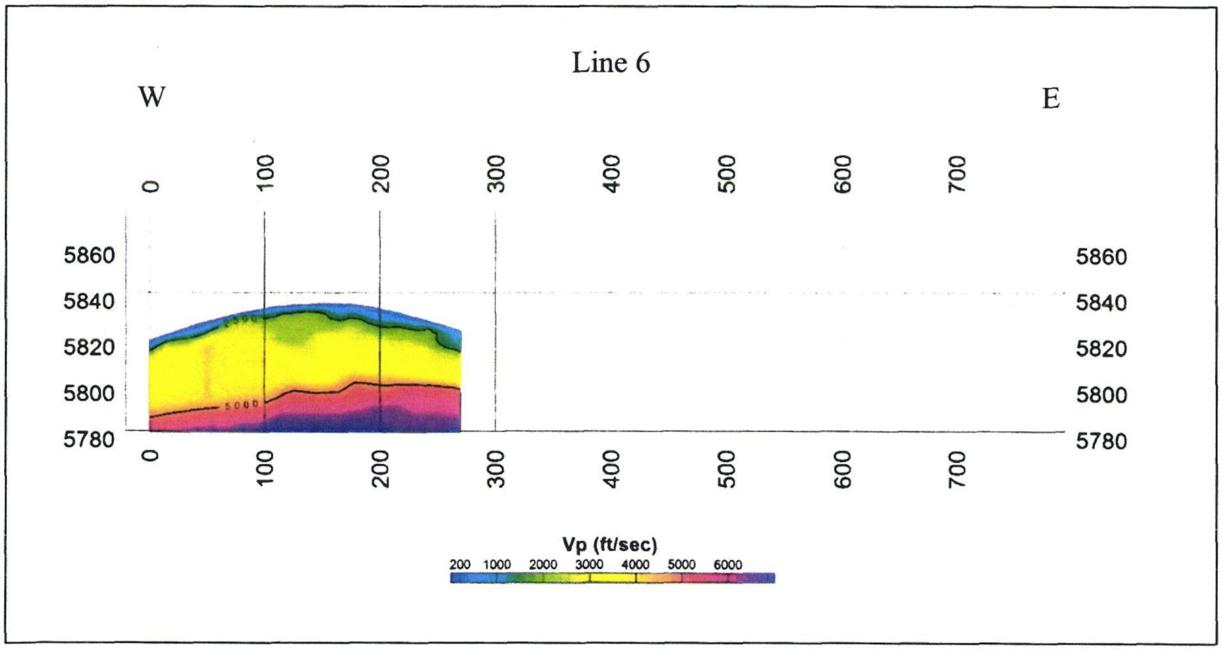

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5780
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Vp (ft/sec)
200 1000 2000 3000 4000 5000 6000

December 19, 2013

RE: SEISMIC REFRACTION SURVEY – DEPTH TO ROCK/RIPPABILITY – CS MINE TAILINGS POND - DAM LOCATION

Based on the project objective and site conditions, Sage Earth Science conducted a seismic refraction tomography survey to map the depth to rock and determine overburden and refractor velocity at the Southern Utah site.

P-wave survey (refraction)

Given a physical setting of increasing density with depth, and by measuring the travel time of a compression wave (*p-wave*) between known points, the seismic refraction method can be used to determine the depth to a refracting horizon(s), the seismic velocity of the refracting horizon(s), as well as thickness and velocities of the overlying materials.

Figure 1. field equipment

Approximately 1,820 feet p-wave refraction profile were acquired. Profiles were located at the site as directed by the customer. Data were acquired in accordance with ASTM standard, **ASTM D 5777-00** *Standard Guide for Using the Seismic Refraction Method for Subsurface Investigation.* Data were reduced using PlotRefra™ seismic refraction tomographic inversion software produced by Geometrics Inc.

Sage Earth Science used a 24-channel engineering seismograph, 600 pound weight drop and 16 lb. sledgehammer to perform the acoustic travel time measurements. Data are collected in 375 foot arrays with 24 geophones, one placed every 16.4 feet along profile. Six records for each 24 channel array were obtained.

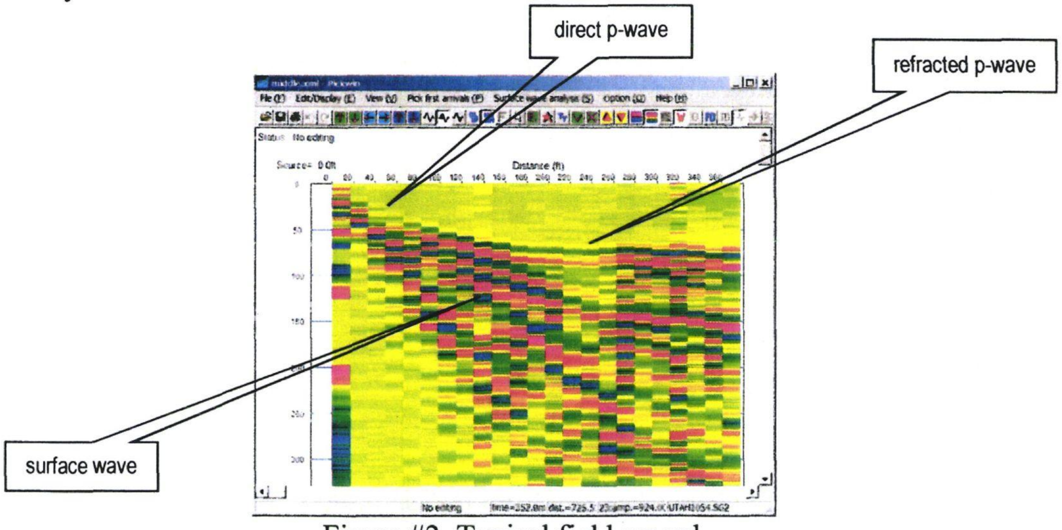


Figure #2 Typical field record

Table 1 Seismic Survey recording parameters

recording instrument	Bison 9024 s/n 6-93913
geophone	Mark products – 4.5 hz. vertical
Geophone/station spacing	16.4 feet (5 meters)
number of channels	24
spread length	377 feet
sample rate	0.25 millisecond
number of samples/channel	8000
record length	2.0 seconds
low pass filter	120 Hz.
low cut filter	4 Hz.
seismic source	16 pound sledge hammer, 600 lb weight drop
source locations	Channels 1,5,10,15,20,24
P-wave refraction	Tomographic inversion PlotRefra™

Profile locations were field located as directed by the customer. Approximate locations are shown in figure 3. Elevation data were obtained from Google Earth and should be considered approximate.

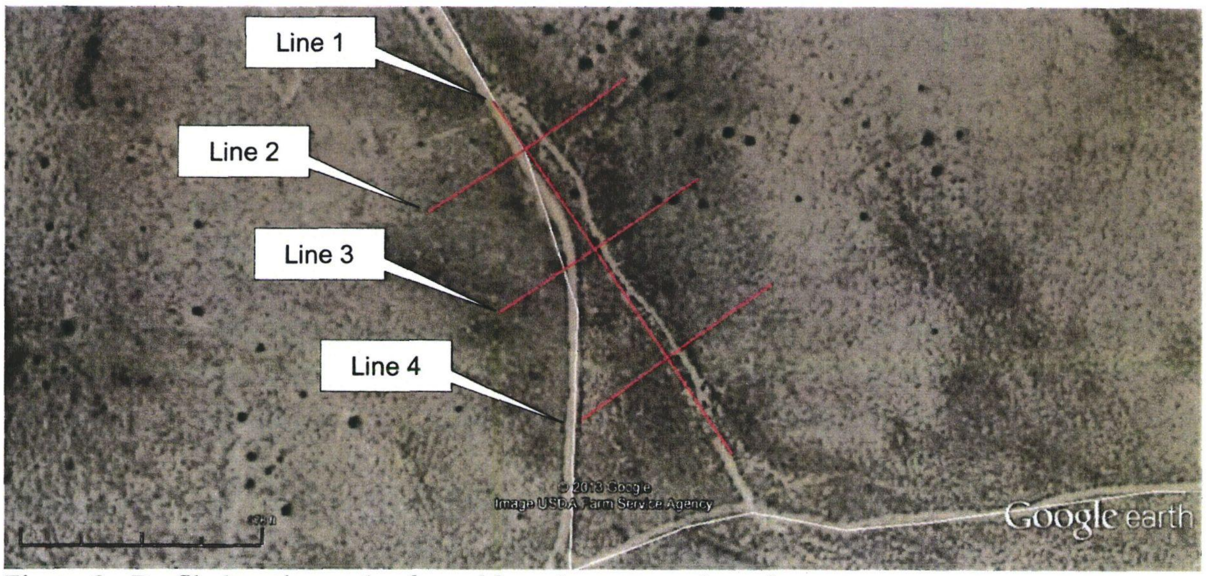


Figure 3. Profile locations. *(scale and locations approximate)*

Discussion

The following figures show the compression wave velocity profiles at the locations show in figure 3. The site is characterized by four general velocity zones. The characterization of materials is based on typical velocities of materials and should be correlated with test pits, borings, or other direct observations.

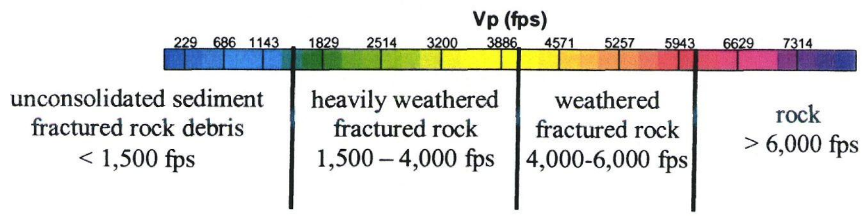
The first velocity zone is a low velocity material exhibiting a velocity below 1,500 feet per second. This material is a low density sediment or unconsolidated weathered material. These materials are shown as blue in the profile figures.

A mid-range velocity zone 1,500 fps - 4,000 fps is likely a heavily weathered or highly fractured rock material or sediment. These materials are shown as green-yellow in the profile figures.

A mid-range velocity zone 4,000 fps - 6,000 fps is likely a heavily weathered or highly fractured rock material. These materials are shown as yellow-orange in the profile figures.

Red-maroon in the profile figures should be considered rock material.

The velocities observed across the site are generally low. According to the Caterpillar Handbook for Ripping, seismic velocities are but one aspect of a rippablity survey and should be used in conjunction with other tests, observations, and experience.



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Clay (saturated)	*3,000-9,000*	*900-2,700*
Sandstone	*6,000-13,000*	*1,800-4,000*
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Chalk	*6,000-13,000*	*1,800-4,000*
Limestone	*7,000-20,000*	*2,100-6,100*
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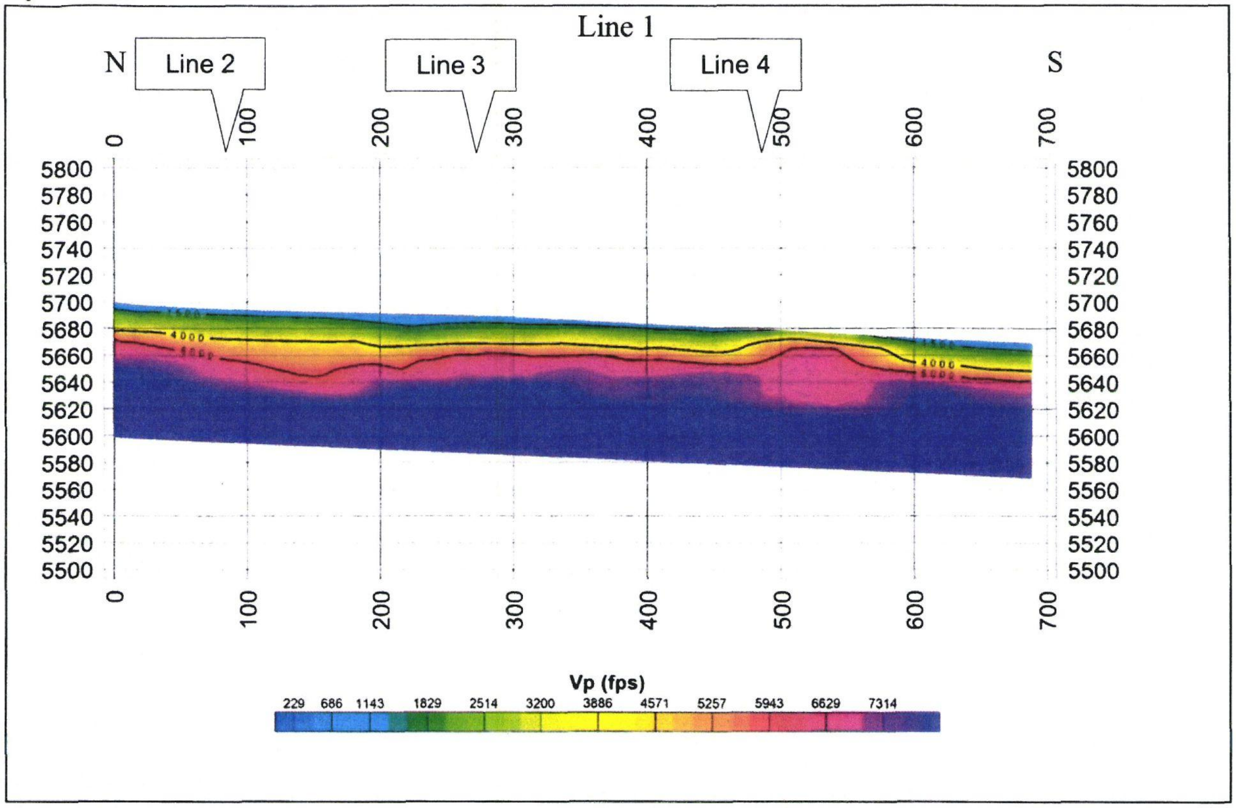
Glen Carpenter / principal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Vp (fps)
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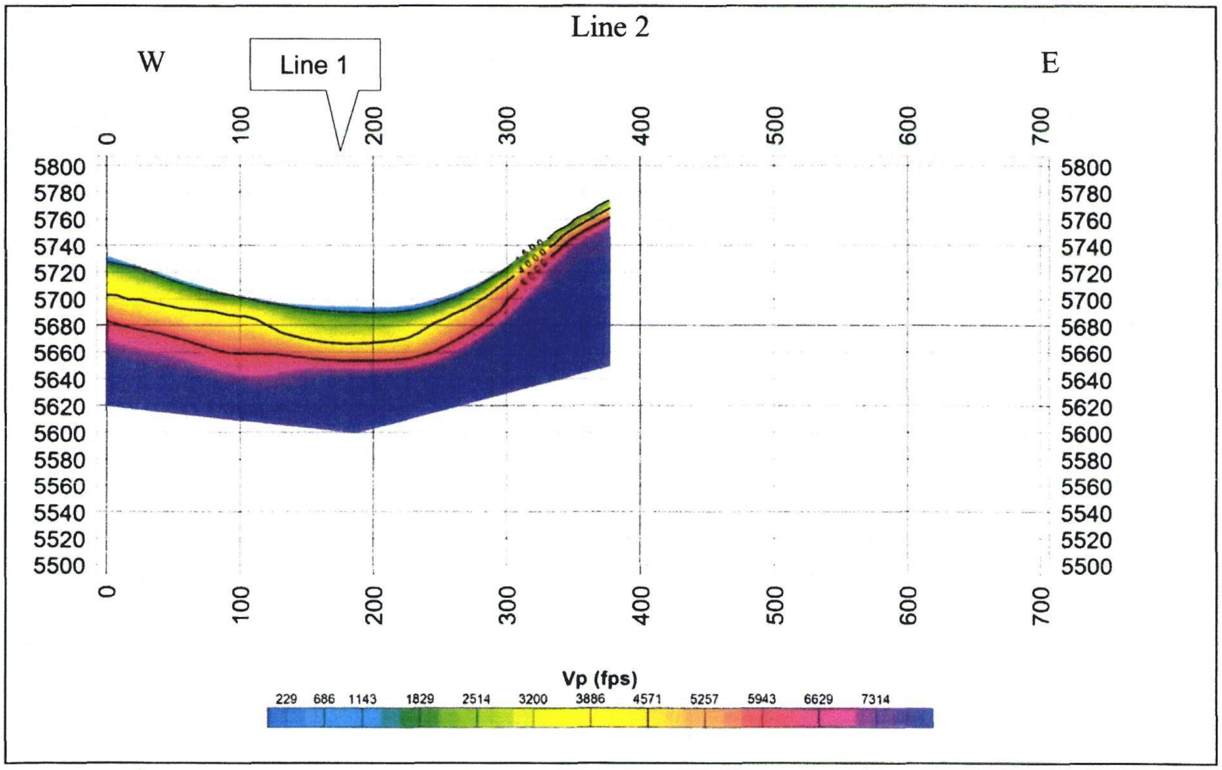
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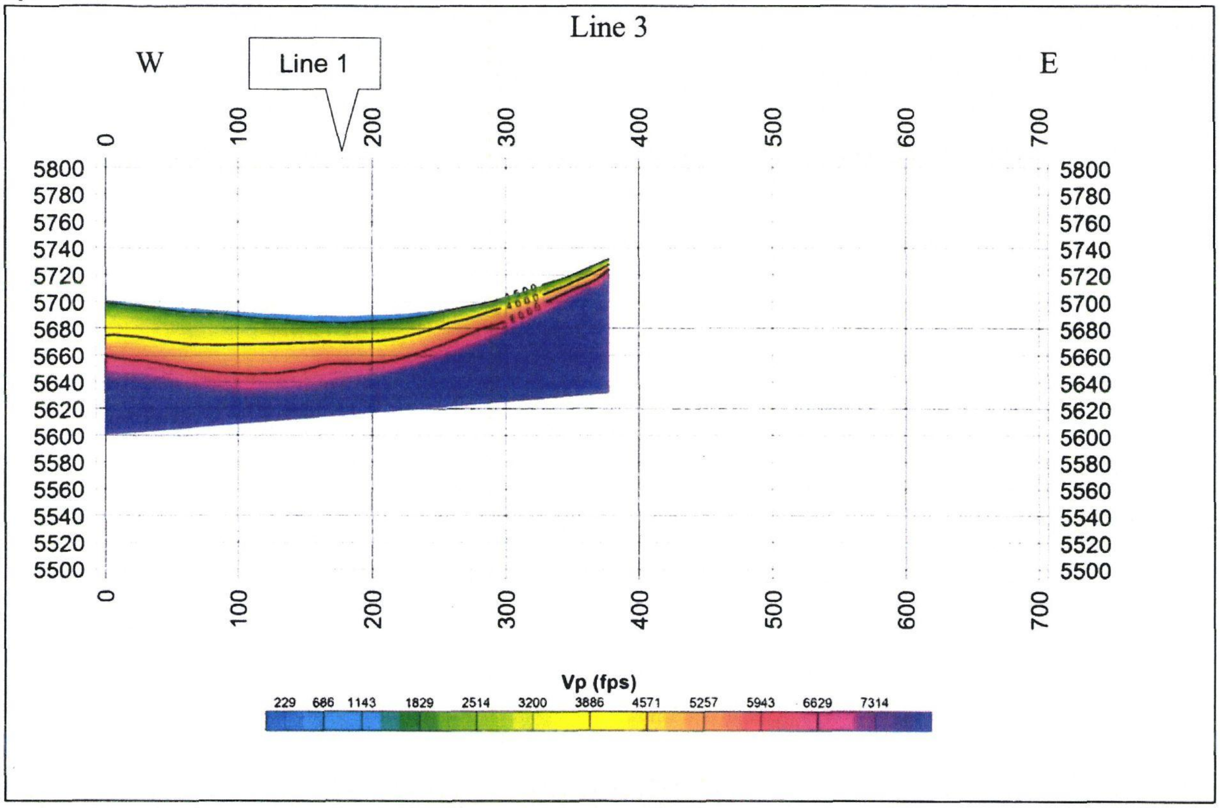

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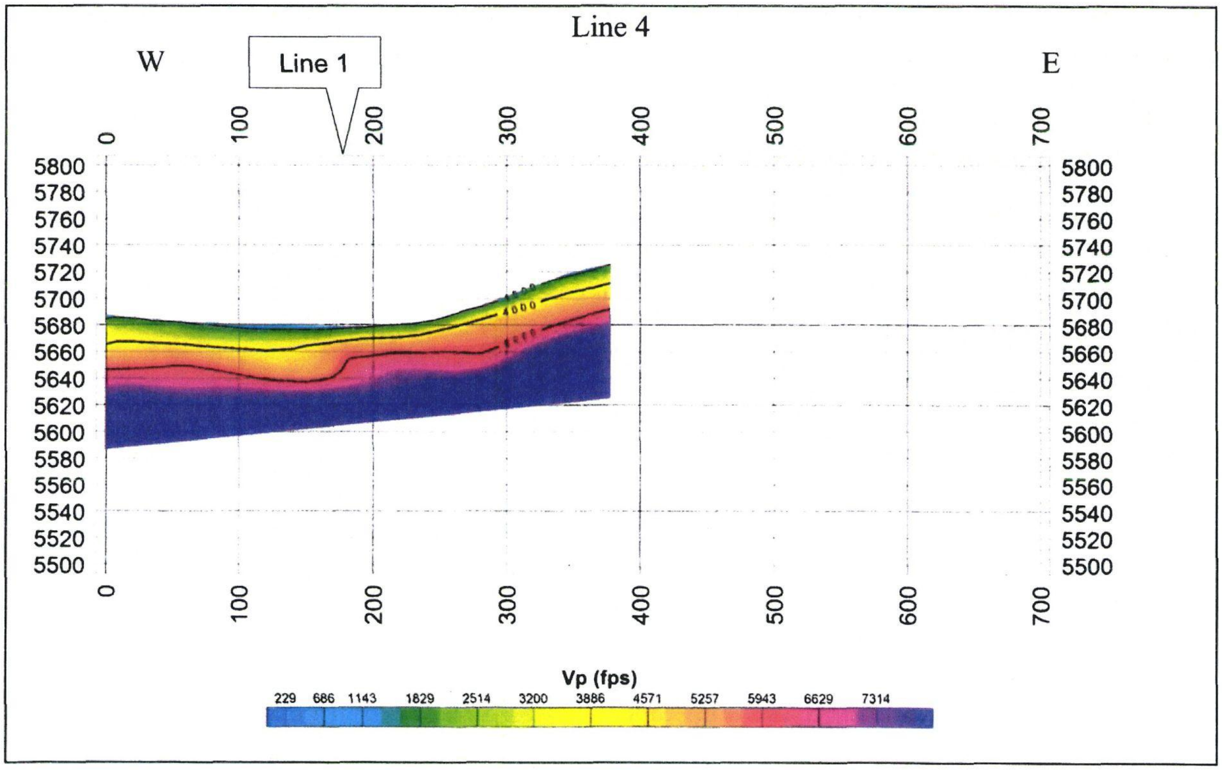

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APPENDIX C

SUMMARY OF LABORATORY TEST RESULTS TABLE

Geotechnical Investigation

Project Number:01640-001, 002, 003

Sample Location ID	Depth (ft)	Dry Density (pcf)	Water Content (%)	Gravel >#4 & <3" (%)	Sand >#200 & <#4 (%)	Fines <#200 (%)	Liquid Limit (%)	PI (%)	Consolidated Undrained Triaxial (c) (psf)	Consolidated Undrained Triaxial (phi) (degrees)	Consolidated Undrained Triaxial (c') (psf)	Consolidated Undrained Triaxial (phi') (degrees)	Direct Shear (c') (psf)	Direct Shear (phi') (degrees)	Permeability (k) (cm/s)	Standard Proctor MDD (psf)	Standard Proctor OMC (%)
TP-1	0-3'			11.4	84.4	4.2									7.10E-04	109.6	8.1
TP-1	7'			18.5	76.6	4.8											
TP-2	2-3'			7.7	76.9	15.4									2.60E-04	126	10.5
TP-2	7-8'			36.3	57.9	5.8									4.10E-04	131.4	8.9
TP-3	1-3'			38.2	47.2	14.6	NP	NP	1076	19.5	77	37.1			2.30E-06	134	8.4
TP-4	3-5'			25.1	43.7	31.2	28	11									
TP-4	5-6'			16.6	68.9	14.5	35	12								122.4	13.0
TP-5	3-4,6			23.1	44.4	32.6	NP	NP					348	34		119.2	12.1
TP-6	2-6'								1034	27	0	39					
TP-6	2-3,5-6			39.9	47.1	12.9	NP	NP							5.90E-05	122	12.4
TP-7	2-3'			11.1	81.7	7.1	NP	NP								120.1	12.2
TP-8	3-4'			7.4	76.8	15.8	NP	NP					180	38		126.3	10.3
TP-9	3-4'			6.4	74.4	19.2	NP	NP					174	37		124	10.4
TP-21	4.5-5'			5.3	86.1	8.6											
TP-24	3-4'			7.2	80.5	12.2			2614	13.4	443	34.5				117.8	13.7
TP-24	5-6'			10.1	79.9	10.0							687	41		119.1	12.9
TP-25	2-3'			15.2	69.6	15.1										115.4	14.5
TP-26	2-3'			4.2	67.6	28.2							255	38		125.2	10.2
TP-29	4-5'			2.2	79.7	18.0							365	40		118.6	13.1
TP-41	4-6'		7.2	9.4	66.8	23.8			674	17.3	81	37.3			1.9E-04 @ 1 ksf	107.9	16.5
															1.6E-04 @ 3 ksf		
															1.4E-04 @ 5 ksf		
TP-42	2-3'		1.8	20.6	66.7	12.7									4.87E-04 @ 2 ksf		
															4.81E-04 @ 4 ksf		
															4.70E-04 @ 6 ksf		
TP-42	5-6'		2.2	12.9	80.2	6.9			6587	10.1	0	37.1				120.3	13.0
TP-43	2-3'		2.2	18.1	66.9	15.0											
TP-43	6-8'		2.9	19.8	63.2	16.9			999	17.2	130	36.7			2.5E-04 @ 1 ksf	125.1	10.0
															2.1E-04 @ 3 ksf		
															1.9E-04 @ 5 ksf		
TP-44	2-3'		2.1	11.8	80.2	8.0											
TP-44	5		3.7	17.4	72.9	9.7			2271	20.2	6	39.1			6.3E-04 @ 2 ksf	122.6	11.9
															5.9E-04 @ 4 ksf		
															5.7E-04 @ 8 ksf		
TP-46	3-4'		17.7	4.9	44.4	50.7											
TP-49	4-6'		5.7	10.5	54.4	35.1										124.5	10.9
TP-51	4-5'		1.7	19.7	74.7	5.6			2577	23.4	0	38.9	505	36	7.92E-04 @ 1 ksf	119.6	11.9
															7.03E-04 @ 3 ksf		
															6.84E-04 @ 5 ksf		
TP-52	4-5'		2.7	20.2	70.8	8.9			2982	14.9	0	37.3	700	36	6.89E-04 @ 2 ksf	123	9.8
															6.87E-04 @ 4 ksf		
															6.84E-04 @ 6 ksf		
TP-53	3-4'		2.5	5.2	79.4	15.5											
TP-55	3-4'		1.8	20.8	70.6	8.7											

Sample Location ID	Depth (ft)	Dry Density (pcf)	Water Content (%)	Gravel >#4 & <3" (%)	Sand >#200 & <#4 (%)	Fines <#200 (%)	Liquid Limit (%)	PI (%)	Consolidated Undrained Triaxial (c) (psf)	Consolidated Undrained Triaxial (phi) (degrees)	Consolidated Undrained Triaxial (c') (psf)	Consolidated Undrained Triaxial (phi') (degrees)	Direct Shear (c') (psf)	Direct Shear (phi') (degrees)	Permeability (k) (cm/s)	Standard Proctor MDD (psf)	Standard Proctor OMC (%)
Tailings Beach																	
1	0						NP	NP									
1,3,5	0								0	27.5	0	37.3					
2	0	97.9	30.6														
3	0						NP	NP									
4	0	96.6	31.3														
5	0						NP	NP									
6	0	97.3	31.5														
7	0						NP	NP					66	32			
8	0	97.1	31.5														

Water Content and Unit Weight of Soil

(In General Accordance with ASTM D7263 Method B and D2216)

IGES

Project: CS Mining Existing Facility Expansion
No: 01640-001 (II)
Location: Milford, UT
Date: 3/15/2013
By: JDF

Sample Info.	Boring No.	Tailings Beach	Tailings Beach	Tailings Beach	Tailings Beach				
	Sample:	2	4	6	8				
	Depth:	Surface	Surface	Surface	Surface				
Unit Weight Info.	Sample height, H (in)	5.970	6.000	5.363	5.363				
	Sample diameter, D (in)	2.416	2.416	2.416	2.416				
	Sample volume, V (ft^3)	0.0158	0.0159	0.0142	0.0142				
	Mass rings + wet soil (g)	1168.96	1924.20	1840.10	1838.40				
	Mass rings/tare (g)	250.38	1008.29	1013.96	1014.37				
	Moist soil, Ws (g)	918.58	915.91	826.14	824.03				
	Moist unit wt., γ_m (pcf)	127.86	126.85	128.01	127.68				
Water Content	Wet soil + tare (g)	1041.51	1036.07	954.42	959.71				
	Dry soil + tare (g)	827.07	818.84	756.58	763.40				
	Tare (g)	127.01	124.10	129.29	140.35				
Water Content, w (%)		**30.6**	**31.3**	**31.5**	**31.5**				
Dry Unit Wt., γ_d (pcf)		**97.9**	**96.6**	**97.3**	**97.1**				

Entered by:__________
Reviewed:__________

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Liquid Limit, Plastic Limit, and Plasticity Index of Soils

(ASTM D4318)

IGES

Project: **CS Mining Existing Facility Expansion**
No: **01640-001 (II)**
Location: Milford, UT
Date: 3/13/2013
By: DKS

Boring No.: **TP-3**
Sample: **Combined Samples**
Depth: **1-3'**
Description: Brown silty sand

Preparation method: Air Dry
Liquid Limit: Could not be determined (N.P.)

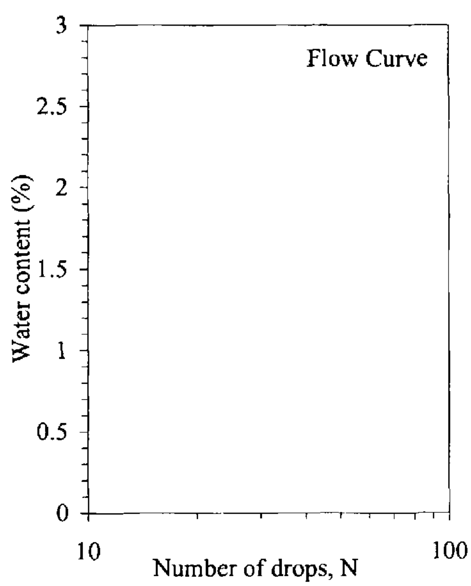
Plastic Limit

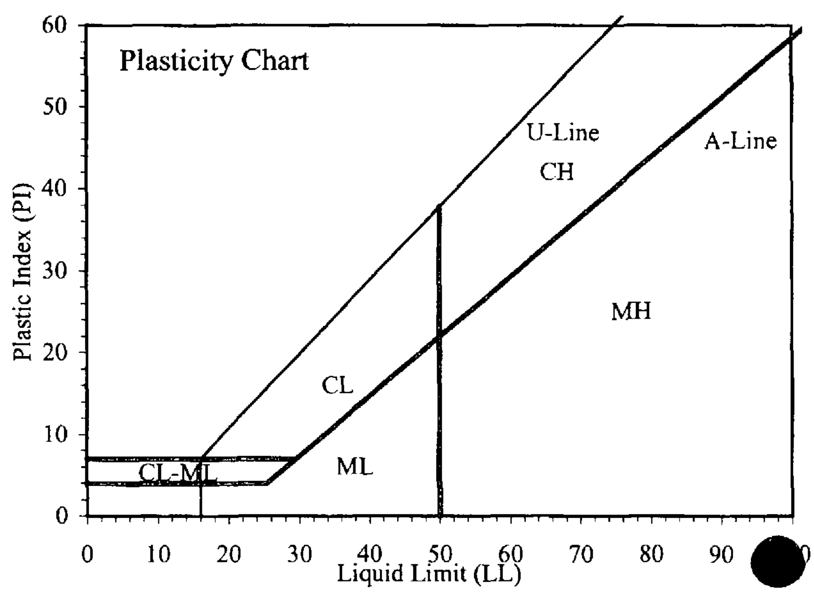
Determination No						
Wet Soil + Tare (g)						
Dry Soil + Tare (g)		Difficult to thread.				
Water Loss (g)						
Tare (g)						
Dry Soil (g)						
Water Content, w (%)						

Liquid Limit: Could not be determined (N.P.)

Determination No						
Number of Drops, N						
Wet Soil + Tare (g)	Unable to obtain an adequate blow count.					
Dry Soil + Tare (g)						
Water Loss (g)						
Tare (g)						
Dry Soil (g)						
Water Content, w (%)						
One-Point LL (%)						

Liquid Limit, LL (%)	**Nonplastic (N.P.)**
Plastic Limit, PL (%)	
Plasticity Index, PI (%)	





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Liquid Limit, Plastic Limit, and Plasticity Index of Soils

(ASTM D4318)

IGES

Project: CS Mining Existing Facility Expansion
No: 01640-001 (II)
Location: Milford, UT
Date: 3/19/2013
By: DKS

Boring No.: TP-4
Sample:
Depth: 3-5'
Description: Brown lean clay

Preparation method: Air Dry
Liquid limit test method: Multipoint

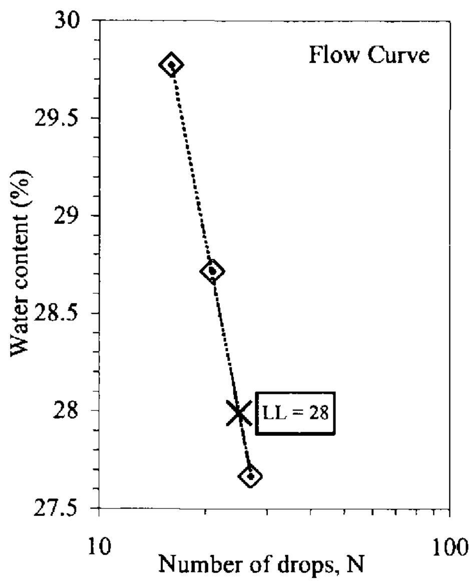
Plastic Limit

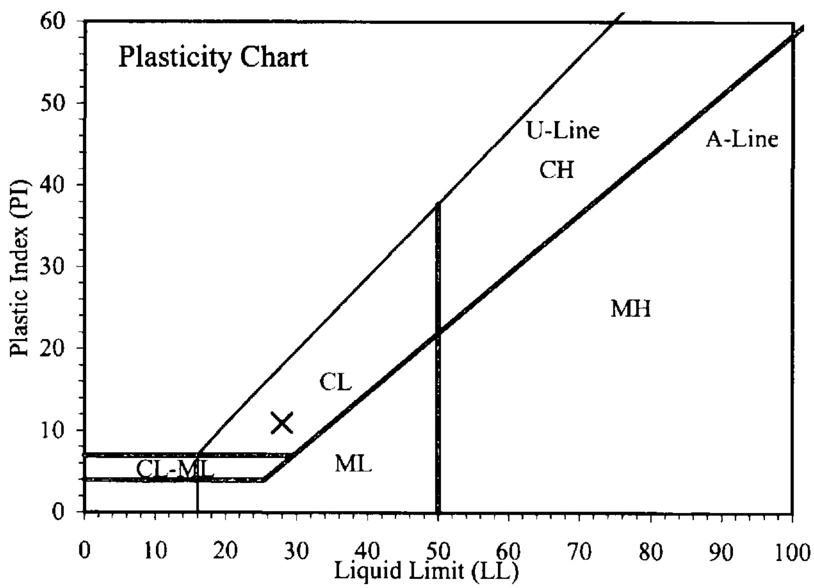
Determination No	1	2				
Wet Soil + Tare (g)	34.48	35.42				
Dry Soil + Tare (g)	32.69	33.50				
Water Loss (g)	1.79	1.92				
Tare (g)	21.88	21.97				
Dry Soil (g)	10.81	11.53				
Water Content, w (%)	16.56	16.65				

Liquid Limit

Determination No	1	2	3			
Number of Drops, N	27	21	16			
Wet Soil + Tare (g)	36.86	35.84	37.70			
Dry Soil + Tare (g)	33.62	32.73	34.02			
Water Loss (g)	3.24	3.11	3.68			
Tare (g)	21.91	21.90	21.66			
Dry Soil (g)	11.71	10.83	12.36			
Water Content, w (%)	27.67	28.72	29.77			
One-Point LL (%)	28	28				

Liquid Limit, LL (%)	**28**
Plastic Limit, PL (%)	**17**
Plasticity Index, PI (%)	**11**





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Liquid Limit, Plastic Limit, and Plasticity Index of Soils

(ASTM D4318)

IGES

Project: CS Mining Existing Facility Expansion
No: 01640-001 (II)
Location: Milford, UT
Date: 3/19/2013
By: DKS

Boring No.: TP-4
Sample:
Depth: 5-6'
Description: Brown lean clay

Preparation method: Air Dry
Liquid limit test method: Multipoint

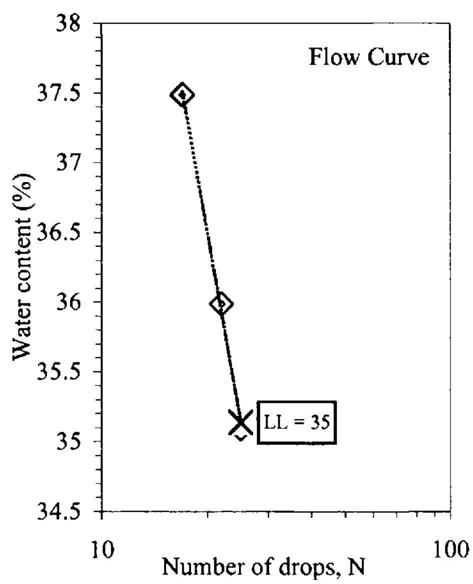
Plastic Limit

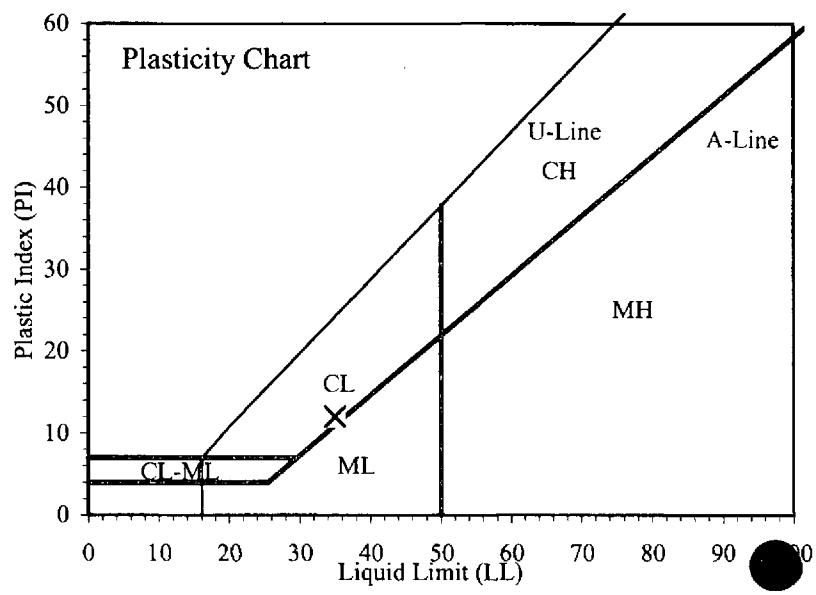
Determination No	1	2				
Wet Soil + Tare (g)	37.58	38.16				
Dry Soil + Tare (g)	34.61	35.05				
Water Loss (g)	2.97	3.11				
Tare (g)	21.55	21.47				
Dry Soil (g)	13.06	13.58				
Water Content, w (%)	22.74	22.90				

Liquid Limit

Determination No	1	2	3			
Number of Drops, N	25	22	17			
Wet Soil + Tare (g)	34.79	34.76	35.72			
Dry Soil + Tare (g)	31.40	31.28	31.90			
Water Loss (g)	3.39	3.48	3.82			
Tare (g)	21.74	21.61	21.71			
Dry Soil (g)	9.66	9.67	10.19			
Water Content, w (%)	35.09	35.99	37.49			
One-Point LL (%)	35	35				

Liquid Limit, LL (%)	**35**
Plastic Limit, PL (%)	**23**
Plasticity Index, PI (%)	**12**





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Liquid Limit, Plastic Limit, and Plasticity Index of Soils
(ASTM D4318)

IGES

Project: CS Mining Existing Facility Expansion
No: 01640-001 (II)
Location: Milford, UT
Date: 3/19/2013
By: DKS

Boring No.: TP-5
Sample: Combined Samples
Depth: 3-4' & 6'
Description: Brown silty sand

Preparation method: Air Dry
Liquid Limit: Could not be determined (N.P.)

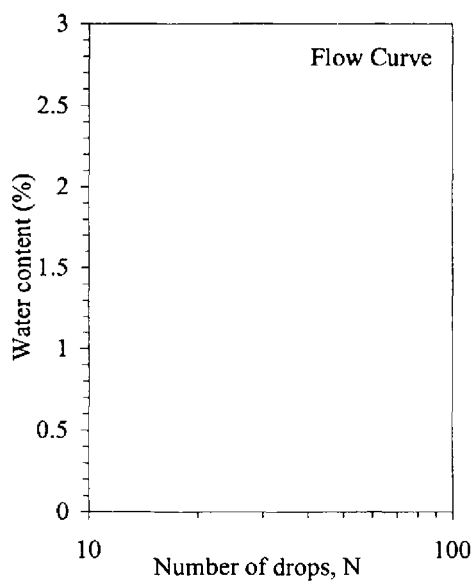
Plastic Limit

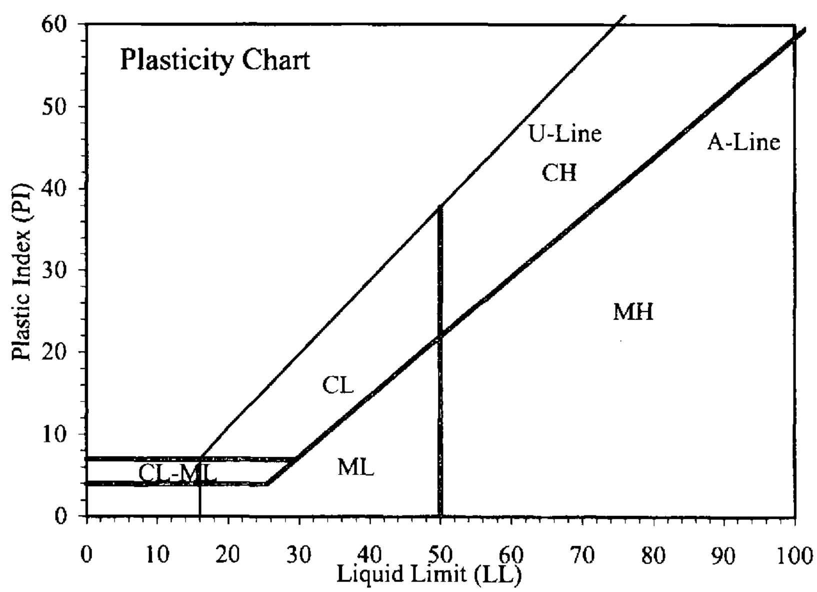
Determination No						
Wet Soil + Tare (g)						
Dry Soil + Tare (g)		Difficult to thread.				
Water Loss (g)						
Tare (g)						
Dry Soil (g)						
Water Content, w (%)						

Liquid Limit: Could not be determined (N.P.)

Determination No						
Number of Drops, N						
Wet Soil + Tare (g)						
Dry Soil + Tare (g)	Unable to obtain an adequate blow count.					
Water Loss (g)						
Tare (g)						
Dry Soil (g)						
Water Content, w (%)						
One-Point LL (%)						

Liquid Limit, LL (%)	**Nonplastic (N.P.)**
Plastic Limit, PL (%)	
Plasticity Index, PI (%)	





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Liquid Limit, Plastic Limit, and Plasticity Index of Soils
(ASTM D4318)

IGES

Project: **CS Mining Existing Facility Expansion**
No: **01640-001 (II)**
Location: Milford, UT
Date: 3/13/2013
By: DKS

Boring No.: **TP-6**
Sample: **Combined Samples**
Depth: **2-3' & 5-6'**
Description: Brown silt

Preparation method: Air Dry
Liquid Limit: Could not be determined (N.P.)

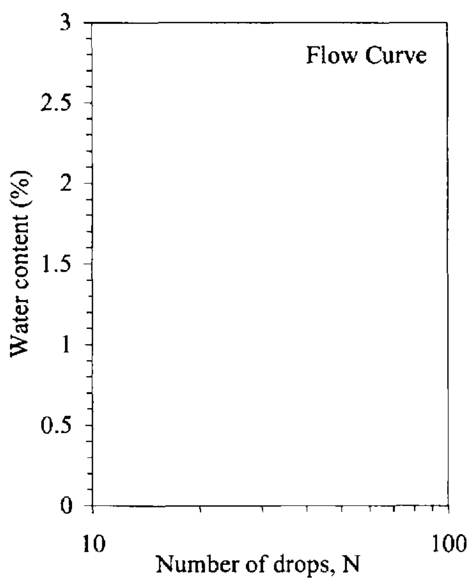
Plastic Limit

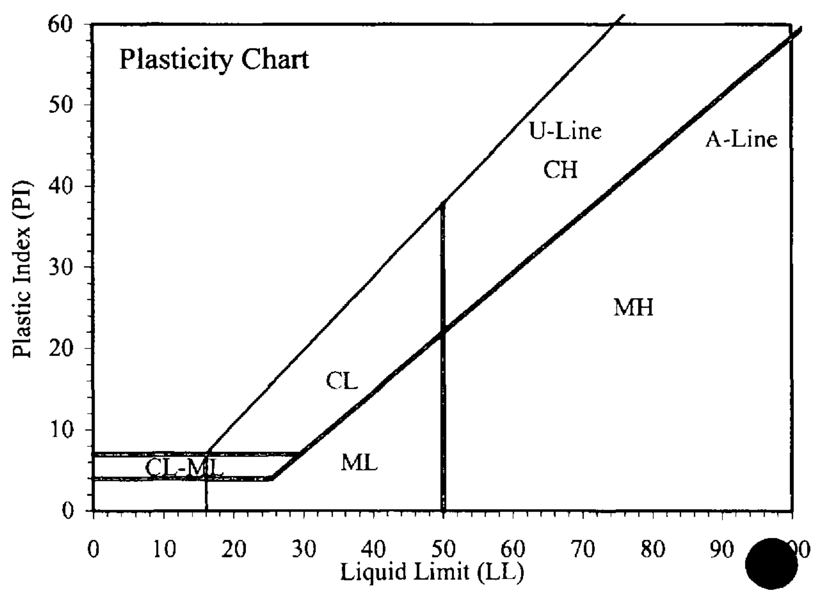
Determination No						
Wet Soil + Tare (g)						
Dry Soil + Tare (g)		Difficult to thread.				
Water Loss (g)						
Tare (g)						
Dry Soil (g)						
Water Content, w (%)						

Liquid Limit: Could not be determined (N.P.)

Determination No						
Number of Drops, N						
Wet Soil + Tare (g)	Unable to obtain an adequate blow count.					
Dry Soil + Tare (g)						
Water Loss (g)						
Tare (g)						
Dry Soil (g)						
Water Content, w (%)						
One-Point LL (%)						

Liquid Limit, LL (%)	**Nonplastic (N.P.)**
Plastic Limit, PL (%)	
Plasticity Index, PI (%)	





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Liquid Limit, Plastic Limit, and Plasticity Index of Soils

(ASTM D4318)

IGES

Project: CS Mining Existing Facility Expansion
No: 01640-001 (II)
Location: Milford, UT
Date: 3/19/2013
By: DKS

Boring No.: TP-7
Sample:
Depth: 2-3'
Description: Brown silty sand

Preparation method: Air Dry
Liquid Limit: Could not be determined (N.P.)

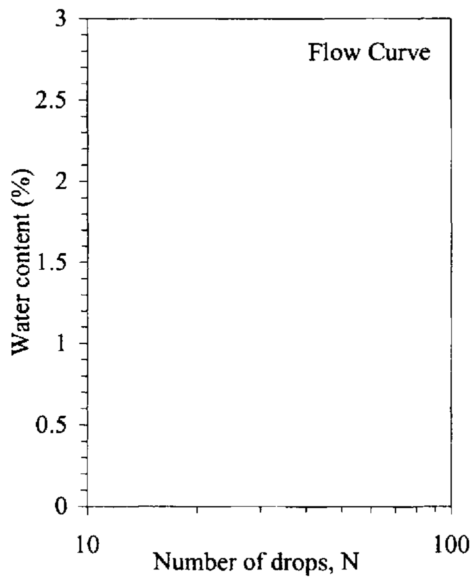
Plastic Limit

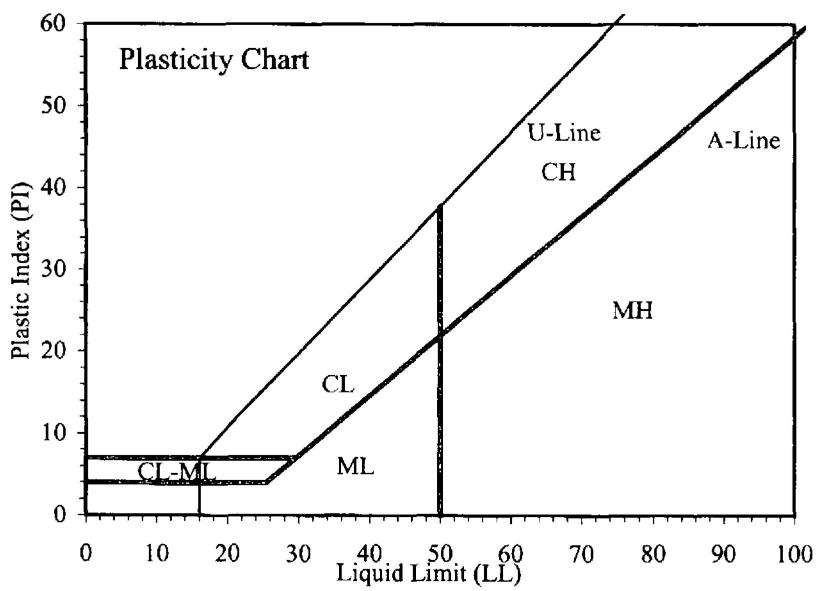
Determination No						
Wet Soil + Tare (g)						
Dry Soil + Tare (g)		Difficult to thread.				
Water Loss (g)						
Tare (g)						
Dry Soil (g)						
Water Content, w (%)						

Liquid Limit: Could not be determined (N.P.)

Determination No						
Number of Drops, N						
Wet Soil + Tare (g)						
Dry Soil + Tare (g)	Unable to obtain an adequate blow count.					
Water Loss (g)						
Tare (g)						
Dry Soil (g)						
Water Content, w (%)						
One-Point LL (%)						

Liquid Limit, LL (%)	**Nonplastic (N.P.)**
Plastic Limit, PL (%)	
Plasticity Index, PI (%)	





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Liquid Limit, Plastic Limit, and Plasticity Index of Soils

(ASTM D4318)

IGES

Project: **CS Mining Existing Facility Expansion**
No: **01640-001 (II)**
Location: Milford, UT
Date: 3/19/2013
By: DKS

Boring No.: **TP-8**
Sample:
Depth: **3-4'**
Description: Brown silty sand

Preparation method: Air Dry
Liquid Limit: Could not be determined (N.P.)

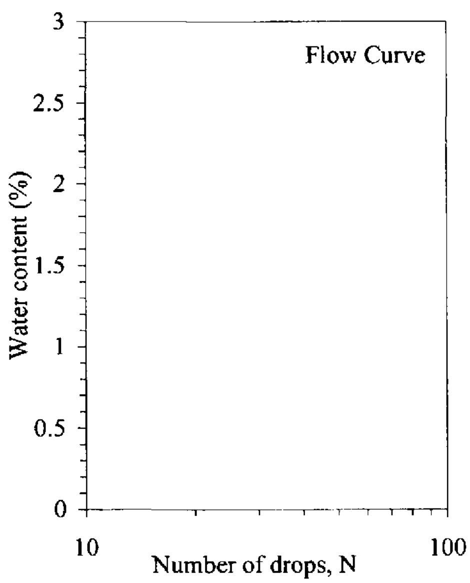
Plastic Limit

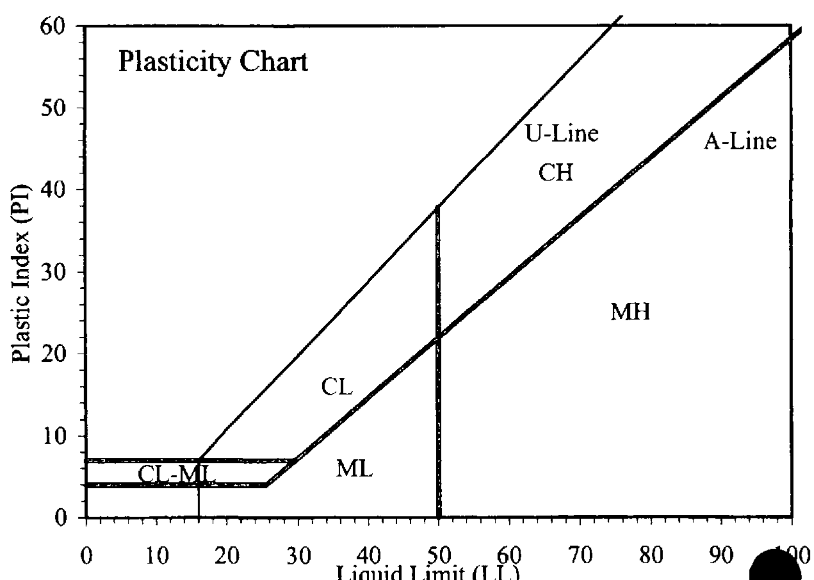
Determination No						
Wet Soil + Tare (g)						
Dry Soil + Tare (g)		Difficult to thread.				
Water Loss (g)						
Tare (g)						
Dry Soil (g)						
Water Content, w (%)						

Liquid Limit: Could not be determined (N.P.)

Determination No						
Number of Drops, N						
Wet Soil + Tare (g)						
Dry Soil + Tare (g)	Unable to obtain an adequate blow count.					
Water Loss (g)						
Tare (g)						
Dry Soil (g)						
Water Content, w (%)						
One-Point LL (%)						

Liquid Limit, LL (%)	**Nonplastic (N.P.)**
Plastic Limit, PL (%)	
Plasticity Index, PI (%)	





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Liquid Limit, Plastic Limit, and Plasticity Index of Soils

(ASTM D4318)

IGES

Project: CS Mining Existing Facility Expansion
No: 01640-001 (II)
Location: Milford, UT
Date: 3/19/2013
By: DKS

Boring No.: TP-9
Sample:
Depth: 3-4'
Description: Brown silty sand

Preparation method: Air Dry
Liquid Limit: Could not be determined (N.P.)

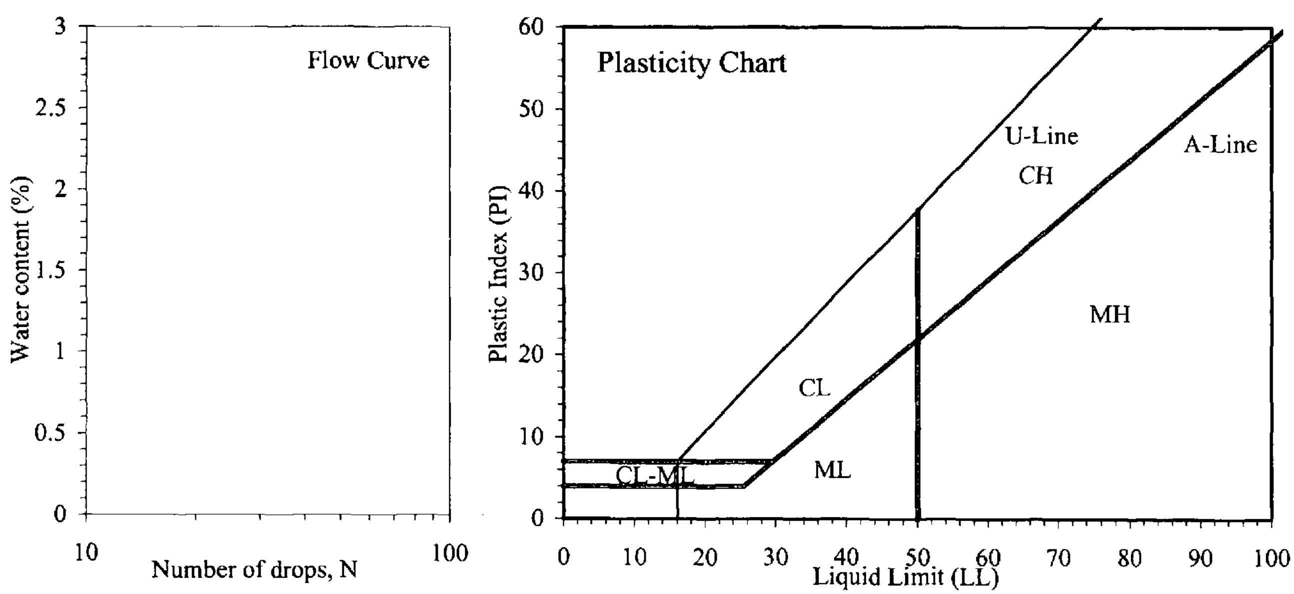
Plastic Limit

Determination No						
Wet Soil + Tare (g)						
Dry Soil + Tare (g)		Difficult to thread.				
Water Loss (g)						
Tare (g)						
Dry Soil (g)						
Water Content, w (%)						

Liquid Limit: Could not be determined (N.P.)

Determination No						
Number of Drops, N						
Wet Soil + Tare (g)						
Dry Soil + Tare (g)	Unable to obtain an adequate blow count.					
Water Loss (g)						
Tare (g)						
Dry Soil (g)						
Water Content, w (%)						
One-Point LL (%)						

Liquid Limit, LL (%)	**Nonplastic (N.P.)**
Plastic Limit, PL (%)	
Plasticity Index, PI (%)	



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Liquid Limit, Plastic Limit, and Plasticity Index of Soils

(ASTM D4318)

IGES

Project: **CS Mining Existing Facility Expansion**
No: **01640-001 (II)**
Location: Milford, UT
Date: 3/20/2013
By: DKS

Boring No.: **Tailings Beach**
Sample: **1**
Depth: **Surface**
Description: Dark grey silty sand

Preparation method: Air Dry
Liquid Limit: Could not be determined (N.P.)

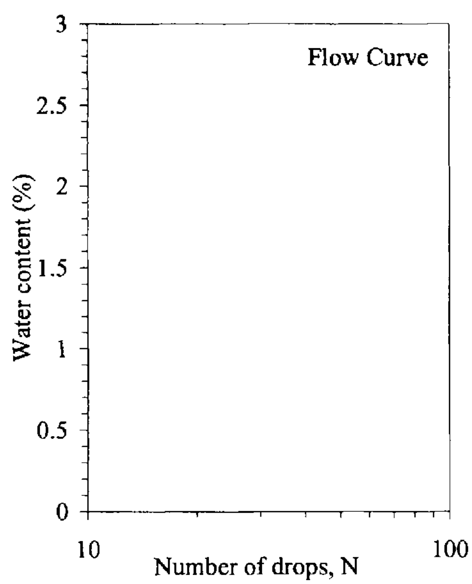
Plastic Limit

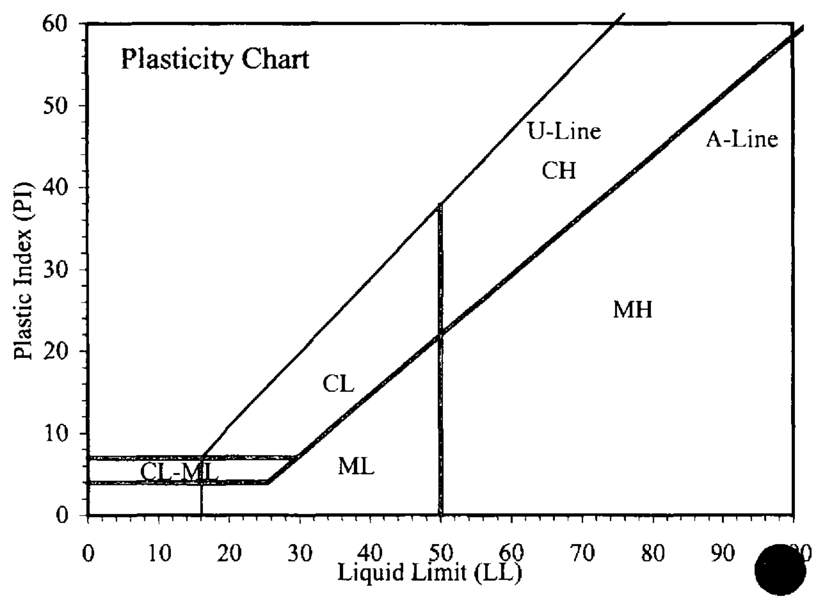
Determination No						
Wet Soil + Tare (g)						
Dry Soil + Tare (g)		Difficult to thread.				
Water Loss (g)						
Tare (g)						
Dry Soil (g)						
Water Content, w (%)						

Liquid Limit: Could not be determined (N.P.)

Determination No						
Number of Drops, N						
Wet Soil + Tare (g)						
Dry Soil + Tare (g)	Unable to obtain an adequate blow count.					
Water Loss (g)						
Tare (g)						
Dry Soil (g)						
Water Content, w (%)						
One-Point LL (%)						

Liquid Limit, LL (%)	**Nonplastic (N.P.)**
Plastic Limit, PL (%)	
Plasticity Index, PI (%)	





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Liquid Limit, Plastic Limit, and Plasticity Index of Soils

(ASTM D4318)

IGES

Project: CS Mining Existing Facility Expansion
No: 01640-001 (II)
Location: Milford, UT
Date: 3/20/2013
By: DKS

Boring No.: Tailings Beach
Sample: 3
Depth: Surface
Description: Dark grey silty sand

Preparation method: Air Dry
Liquid Limit: Could not be determined (N.P.)

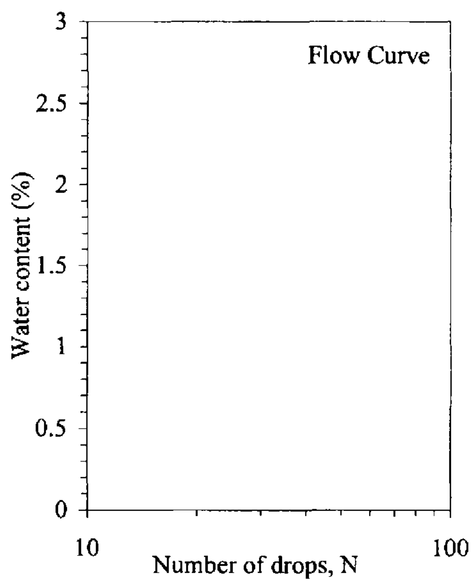
Plastic Limit

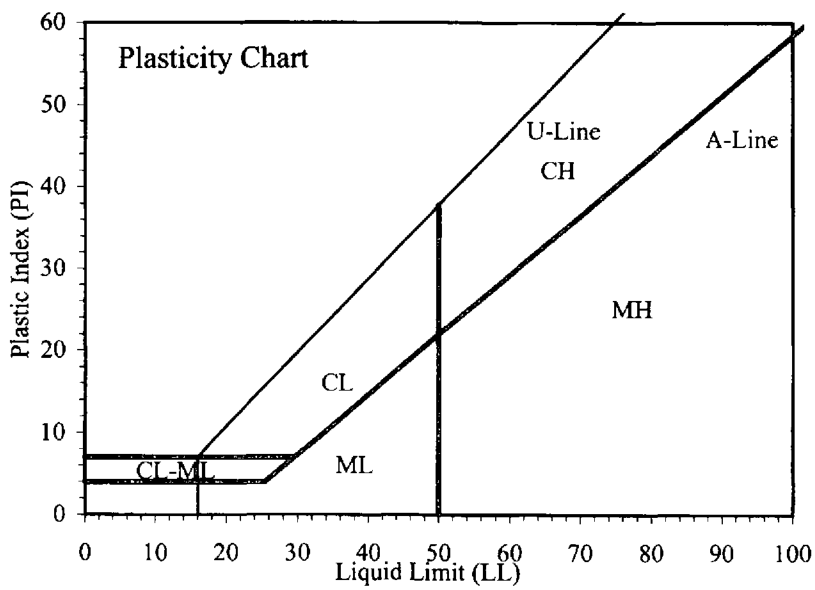
Determination No						
Wet Soil + Tare (g)						
Dry Soil + Tare (g)		Difficult to thread.				
Water Loss (g)						
Tare (g)						
Dry Soil (g)						
Water Content, w (%)						

Liquid Limit: Could not be determined (N.P.)

Determination No						
Number of Drops, N						
Wet Soil + Tare (g)						
Dry Soil + Tare (g)	Unable to obtain an adequate blow count.					
Water Loss (g)						
Tare (g)						
Dry Soil (g)						
Water Content, w (%)						
One-Point LL (%)						

Liquid Limit, LL (%)	**Nonplastic (N.P.)**
Plastic Limit, PL (%)	
Plasticity Index, PI (%)	





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Liquid Limit, Plastic Limit, and Plasticity Index of Soils

(ASTM D4318)

Project: CS Mining Existing Facility Expansion
No: 01640-001 (II)
Location: Milford, UT
Date: 3/20/2013
By: DKS

Boring No.: Tailings Beach
Sample: 5
Depth: Surface
Description: Dark grey silty sand

Preparation method: Air Dry
Liquid Limit: Could not be determined (N.P.)

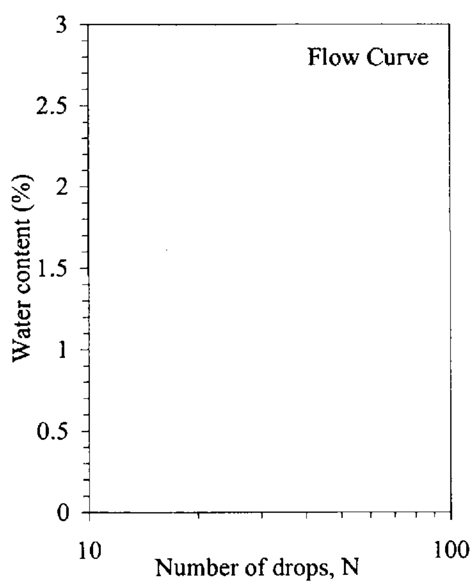
Plastic Limit

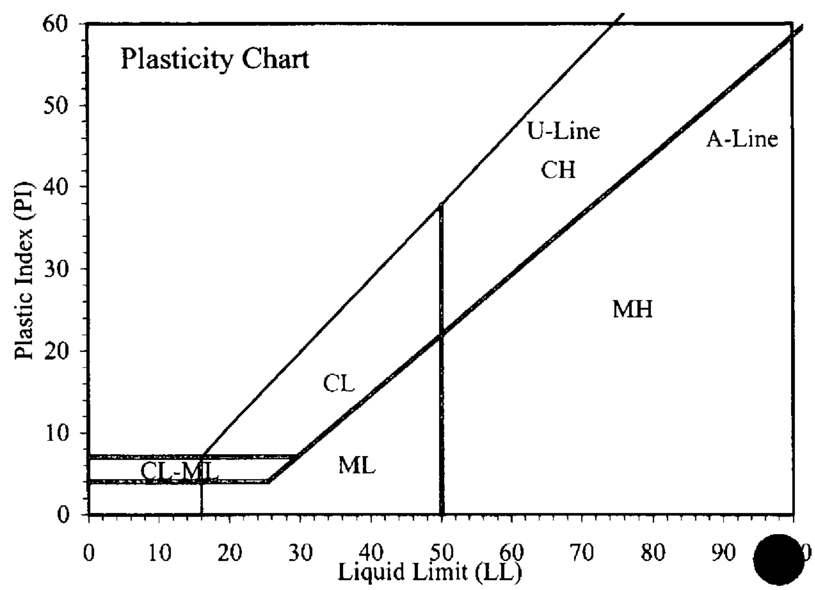
Determination No						
Wet Soil + Tare (g)						
Dry Soil + Tare (g)		Difficult to thread.				
Water Loss (g)						
Tare (g)						
Dry Soil (g)						
Water Content, w (%)						

Liquid Limit: Could not be determined (N.P.)

Determination No						
Number of Drops, N						
Wet Soil + Tare (g)						
Dry Soil + Tare (g)	Unable to obtain an adequate blow count.					
Water Loss (g)						
Tare (g)						
Dry Soil (g)						
Water Content, w (%)						
One-Point LL (%)						

Liquid Limit, LL (%)	**Nonplastic (N.P.)**
Plastic Limit, PL (%)	
Plasticity Index, PI (%)	





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Liquid Limit, Plastic Limit, and Plasticity Index of Soils

(ASTM D4318)

IGES

Project: CS Mining Existing Facility Expansion
No: 01640-001 (II)
Location: Milford, UT
Date: 3/19/2013
By: DKS

Boring No.: Tailings Beach
Sample: 7
Depth: Surface
Description: Dark grey silty sand

Preparation method: Air Dry
Liquid Limit: Could not be determined (N.P.)

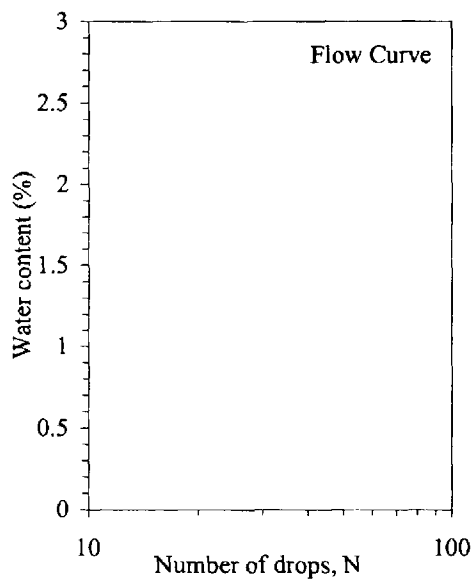
Plastic Limit

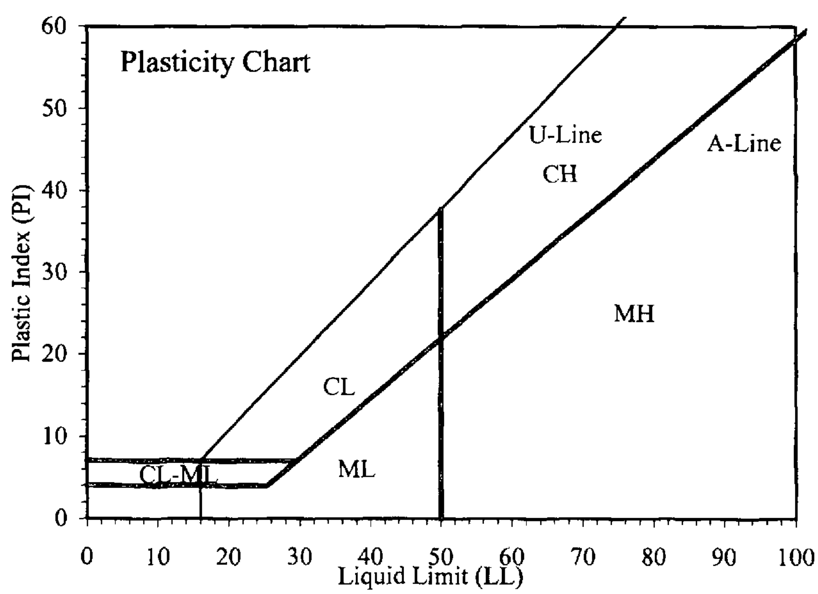
Determination No						
Wet Soil + Tare (g)						
Dry Soil + Tare (g)		Difficult to thread.				
Water Loss (g)						
Tare (g)						
Dry Soil (g)						
Water Content, w (%)						

Liquid Limit: Could not be determined (N.P.)

Determination No						
Number of Drops, N						
Wet Soil + Tare (g)						
Dry Soil + Tare (g)	Unable to obtain an adequate blow count.					
Water Loss (g)						
Tare (g)						
Dry Soil (g)						
Water Content, w (%)						
One-Point LL (%)						

Liquid Limit, LL (%)	**Nonplastic (N.P.)**
Plastic Limit, PL (%)	
Plasticity Index, PI (%)	





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Reviewed:__________

Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis

(ASTM D6913)

IGES

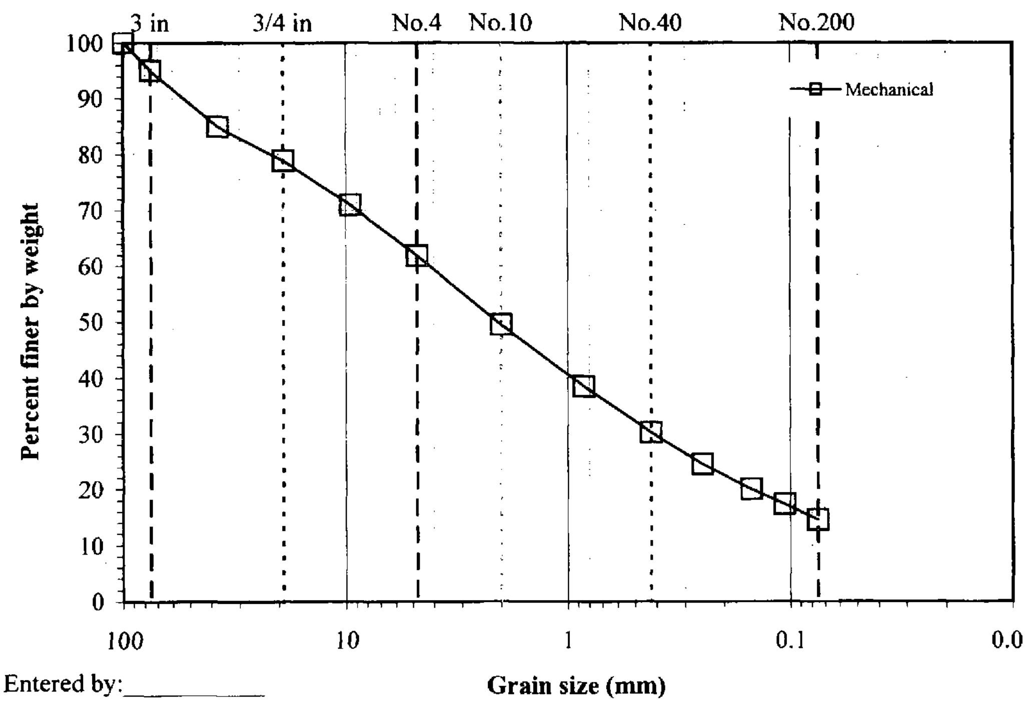
Project: CS Mining Existing Facility Expansion
No: 01640-001 (II)
Location: Milford, UT
Date: 3/13/2013
By: BRR

Boring No.: TP-3
Sample: Combined Samples
Depth: 1-3'
Description: Brown silty sand with gravel

Split:	Yes	
Split sieve:	3/4"	
	Moist	Dry
Total sample wt. (g):	51492.80	49124.9
+3/4" Coarse fraction (g):	10584.6	10420.4
-3/4" Split fraction (g):	1428.46	1351.51
Split fraction:	0.788	

Water content data	C.F.(+3/4")	S.F.(-3/4")
Moist soil + tare (g):	1382.89	1837.27
Dry soil + tare (g):	1364.78	1760.32
Tare (g):	215.39	408.81
Water content (%):	1.6	5.7

Sieve	Accum. Wt. Ret. (g)	Grain Size (mm)	Percent Finer	
8"	-	200	-	
6"	-	150	-	
4"	-	100	100.0	
3"	2486.62	75	94.9	
1.5"	7432.20	37.5	84.9	
3/4"	10420.41	19	78.8	←Split
3/8"	135.15	9.5	70.9	
No.4	292.17	4.75	61.8	
No.10	504.60	2	49.4	
No.20	692.94	0.85	38.4	
No.40	832.15	0.425	30.3	
No.60	930.44	0.25	24.5	
No.100	1008.26	0.15	20.0	
No.140	1054.23	0.106	17.3	
No.200	1101.47	0.075	14.6	



Gravel (%): 38.2
Sand (%): 47.2
Fines (%): 14.6

Entered by:__________
Reviewed:__________

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Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis

(ASTM D6913)

IGES

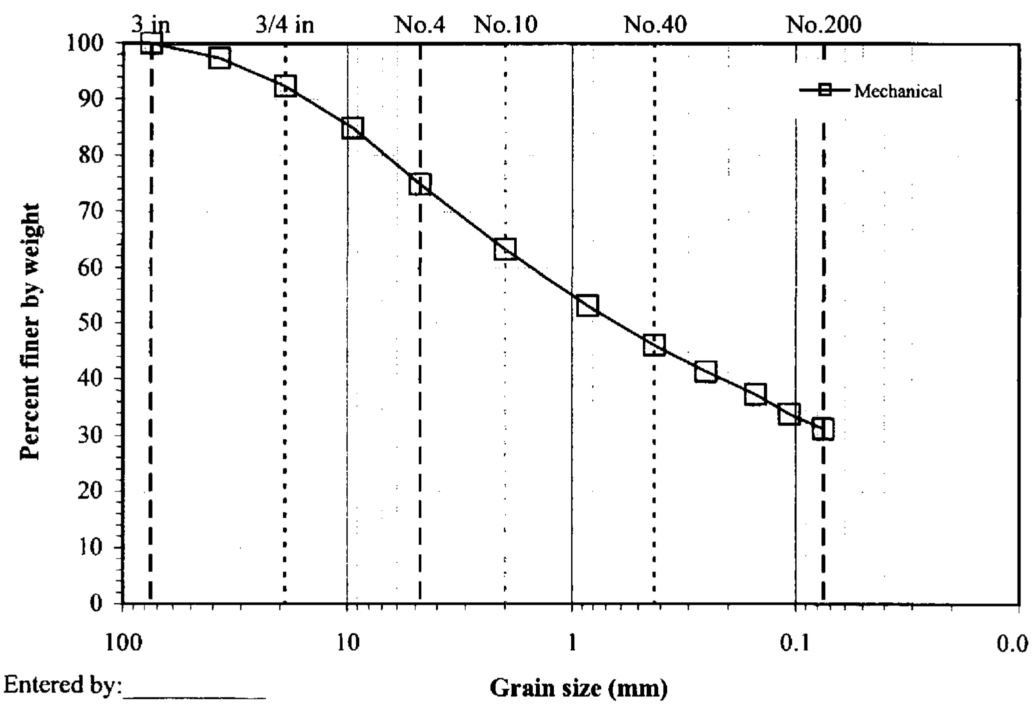
Project: CS Mining Existing Facility Expansion
No: 01640-001 (II)
Location: Milford, UT
Date: 3/19/2013
By: BRR

Boring No.: TP-4
Sample:
Depth: 3-5'
Description: Brown clayey sand with gravel

Split:	Yes	
Split sieve:	3/4"	
	Moist	Dry
Total sample wt. (g):	24749.68	23534.9
+3/4" Coarse fraction (g):	1814.48	1790.9
-3/4" Split fraction (g):	1493.41	1415.85
Split fraction:	0.924	

Water content data	C.F.(+3/4")	S.F.(-3/4")
Moist soil + tare (g):	2026.03	1901.93
Dry soil + tare (g):	2002.42	1824.37
Tare (g):	211.56	408.52
Water content (%):	1.3	5.5

Sieve	Accum. Wt. Ret. (g)	Grain Size (mm)	Percent Finer	
8"	-	200	-	
6"	-	150	-	
4"	-	100	-	
3"	-	75	100.0	
1.5"	619.31	37.5	97.4	
3/4"	1790.87	19	92.4	←Split
3/8"	114.98	9.5	84.9	
No.4	268.60	4.75	74.9	
No.10	446.53	2	63.3	
No.20	603.06	0.85	53.0	
No.40	709.62	0.425	46.1	
No.60	782.82	0.25	41.3	
No.100	844.50	0.15	37.3	
No.140	897.82	0.106	33.8	
No.200	937.22	0.075	31.2	



Gravel (%): 25.1
Sand (%): 43.6
Fines (%): 31.2

Entered by:__________
Reviewed:__________

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Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis

(ASTM D6913)

IGES

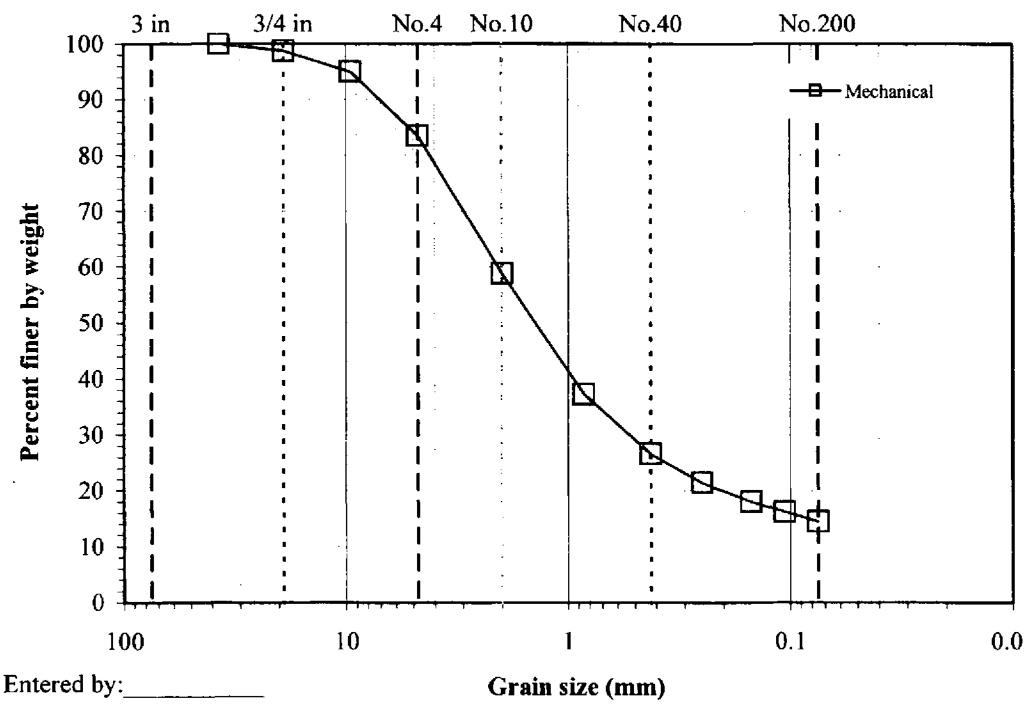
Project: CS Mining Existing Facility Expansion
No: 01640-001 (II)
Location: Milford, UT
Date: 3/19/2013
By: BRR

Boring No.: TP-4
Sample:
Depth: 5-6'
Description: Light brown clayey sand with gravel

Split:	Yes	
Split sieve:	3/8"	
	Moist	Dry
Total sample wt. (g):	24740.03	23683.0
+3/8" Coarse fraction (g):	1200.53	1181.0
-3/8" Split fraction (g):	1333.15	1274.39
Split fraction:	0.950	

Water content data	C.F.(+3/8")	S.F.(-3/8")
Moist soil + tare (g):	1424.10	1643.73
Dry soil + tare (g):	1404.61	1584.97
Tare (g):	223.56	310.58
Water content (%):	1.7	4.6

Sieve	Accum. Wt. Ret. (g)	Grain Size (mm)	Percent Finer	
8"	-	200	-	
6"	-	150	-	
4"	-	100	-	
3"	-	75	-	
1.5"	-	37.5	100.0	
3/4"	310.72	19	98.7	
3/8"	1181.04	9.5	95.0	←Split
No.4	155.30	4.75	83.4	
No.10	486.00	2	58.8	
No.20	774.33	0.85	37.3	
No.40	917.02	0.425	26.6	
No.60	986.29	0.25	21.5	
No.100	1032.02	0.15	18.1	
No.140	1057.20	0.106	16.2	
No.200	1080.10	0.075	14.5	



Gravel (%): 16.6
Sand (%): 68.9
Fines (%): 14.5

Entered by:__________
Reviewed:__________

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Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis

(ASTM D6913)

IGES

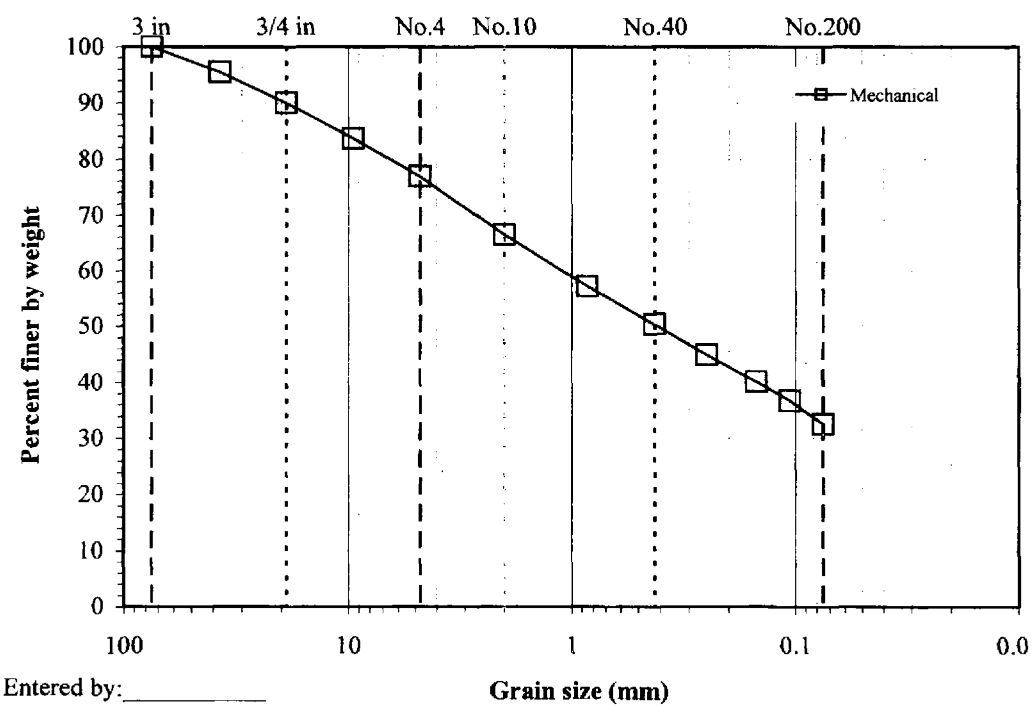
Project: CS Mining Existing Facility Expansion
No: 01640-001 (II)
Location: Milford, UT
Date: 3/19/2013
By: BRR

Boring No.: TP-5
Sample: Combined Samples
Depth: 3-4' & 6'
Description: Brown silty sand with gravel

Split:	Yes	
Split sieve:	3/4"	
	Moist	Dry
Total sample wt. (g):	29937.60	27914.3
+3/4" Coarse fraction (g):	2835.1	2770.24
-3/4" Split fraction (g):	1462.75	1357.05
Split fraction:	0.901	

Water content data	C.F.(+3/4")	S.F.(-3/4")
Moist soil + tare (g):	1162.34	1872.56
Dry soil + tare (g):	1145.97	1766.86
Tare (g):	446.79	409.81
Water content (%):	2.3	7.8

Sieve	Accum. Wt. Ret. (g)	Grain Size (mm)	Percent Finer	
8"	-	200	-	
6"	-	150	-	
4"	-	100	-	
3"	-	75	100.0	
1.5"	1238.99	37.5	95.6	
3/4"	2770.24	19	90.1	←Split
3/8"	96.87	9.5	83.6	
No.4	198.12	4.75	76.9	
No.10	356.19	2	66.4	
No.20	495.76	0.85	57.2	
No.40	598.96	0.425	50.3	
No.60	680.14	0.25	44.9	
No.100	753.83	0.15	40.0	
No.140	804.63	0.106	36.7	
No.200	866.29	0.075	32.6	



Gravel (%): 23.1
Sand (%): 44.4
Fines (%): 32.6

Entered by:___________

Reviewed:___________

Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis

(ASTM D6913)

IGES

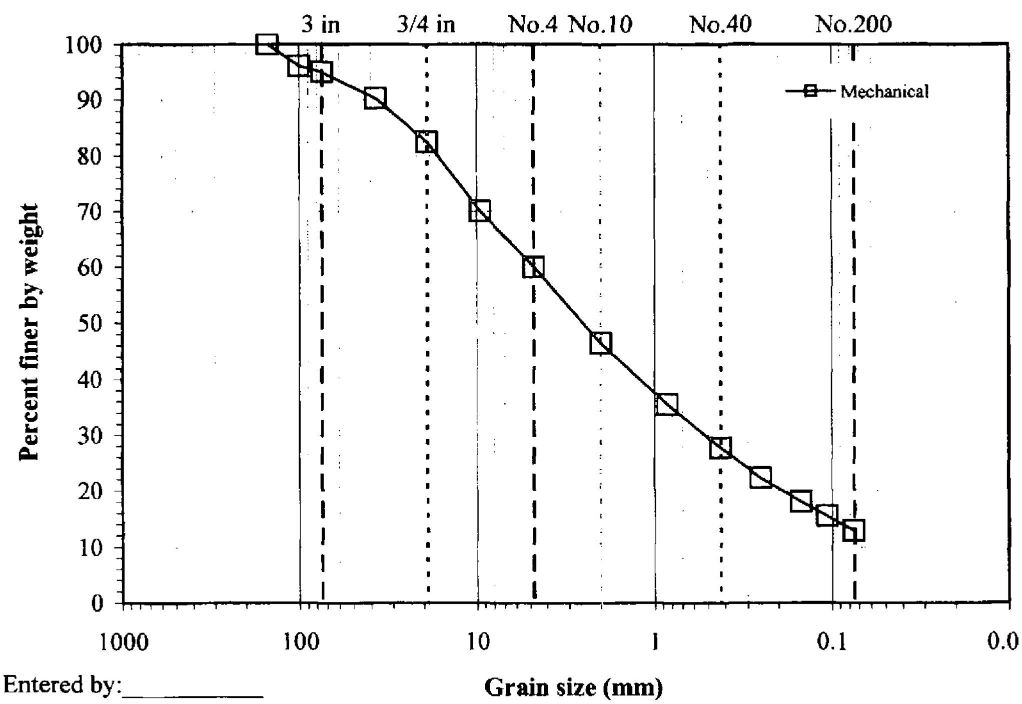
Project: CS Mining Existing Facility Expansion
No: 01640-001 (II)
Location: Milford, UT
Date: 3/12/2013
By: BRR

Boring No.: TP-6
Sample: Combined Samples
Depth: 2-3' & 5-6'
Description: Brown silty sand with gravel

Split:	Yes	
Split sieve:	3/4"	
	Moist	Dry
Total sample wt. (g):	54142.50	51306.5
+3/4" Coarse fraction (g):	9270.1	9041.3
-3/4" Split fraction (g):	1411.32	1329.32
Split fraction:	0.824	

Water content data	C.F.(+3/4")	S.F.(-3/4")
Moist soil + tare (g):	1608.92	1821.81
Dry soil + tare (g):	1579.30	1739.81
Tare (g):	408.93	410.49
Water content (%):	2.5	6.2

Sieve	Accum. Wt. Ret. (g)	Grain Size (mm)	Percent Finer	
8"	-	200	-	
6"	-	150	100.0	
4"	2001.06	100	96.1	
3"	2580.78	75	95.0	
1.5"	5025.03	37.5	90.2	
3/4"	9041.28	19	82.4	←Split
3/8"	200.51	9.5	70.0	
No.4	360.09	4.75	60.1	
No.10	579.84	2	46.4	
No.20	757.12	0.85	35.5	
No.40	882.23	0.425	27.7	
No.60	969.19	0.25	22.3	
No.100	1036.91	0.15	18.1	
No.140	1078.58	0.106	15.5	
No.200	1120.82	0.075	12.9	



Gravel (%): 39.9
Sand (%): 47.1
Fines (%): 12.9

Entered by:__________
Reviewed:__________

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Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis

(ASTM D6913)

IGES

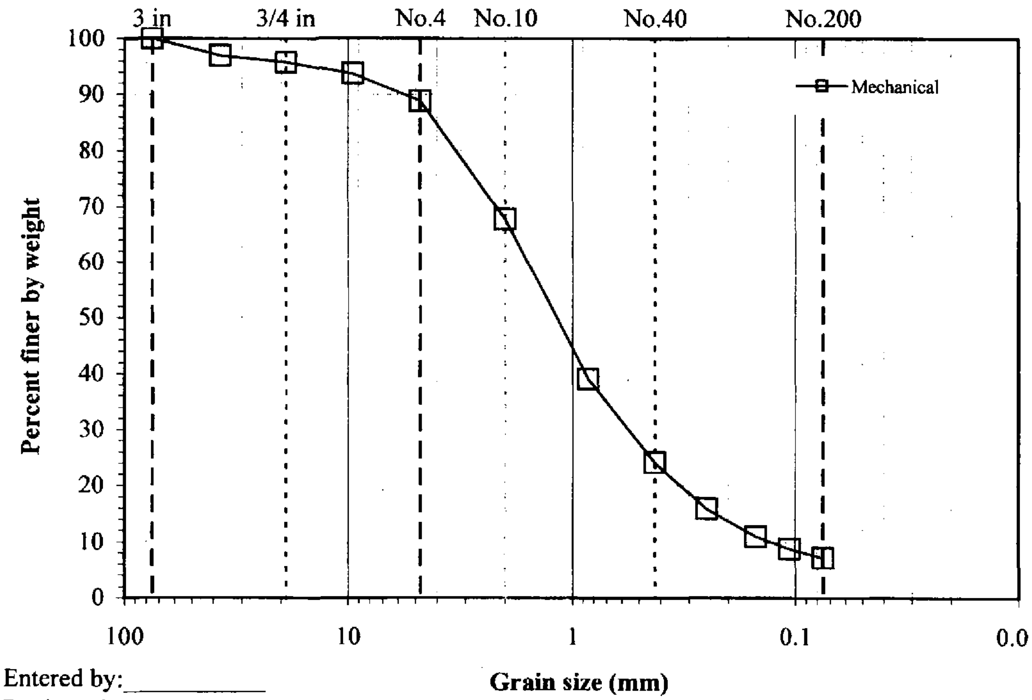
Project: CS Mining Existing Facility Expansion
No: 01640-001 (II)
Location: Milford, UT
Date: 3/19/2013
By: BRR

Boring No.: TP-7
Sample:
Depth: 2-3'
Description: Brown sand with silt

Split:	Yes	
Split sieve:	3/4"	
	Moist	Dry
Total sample wt. (g):	27690.11	26689.7
+3/4" Coarse fraction (g):	1167.91	1148.9
-3/4" Split fraction (g):	1497.66	1442.24
Split fraction:	0.957	

Water content data	C.F.(+3/4")	S.F.(-3/4")
Moist soil + tare (g):	1387.12	1813.48
Dry soil + tare (g):	1368.10	1758.06
Tare (g):	219.18	315.82
Water content (%):	1.7	3.8

Sieve	Accum. Wt. Ret. (g)	Grain Size (mm)	Percent Finer	
8"	-	200	-	
6"	-	150	-	
4"	-	100	-	
3"	-	75	100.0	
1.5"	822.88	37.5	96.9	
3/4"	1148.89	19	95.7	←Split
3/8"	31.41	9.5	93.6	
No.4	102.75	4.75	88.9	
No.10	422.36	2	67.7	
No.20	854.17	0.85	39.0	
No.40	1078.68	0.425	24.1	
No.60	1203.08	0.25	15.9	
No.100	1277.34	0.15	10.9	
No.140	1310.37	0.106	8.7	
No.200	1334.73	0.075	7.1	



Gravel (%): 11.1
Sand (%): 81.7
Fines (%): 7.1

Entered by:__________
Reviewed:__________

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Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis

(ASTM D6913)

IGES

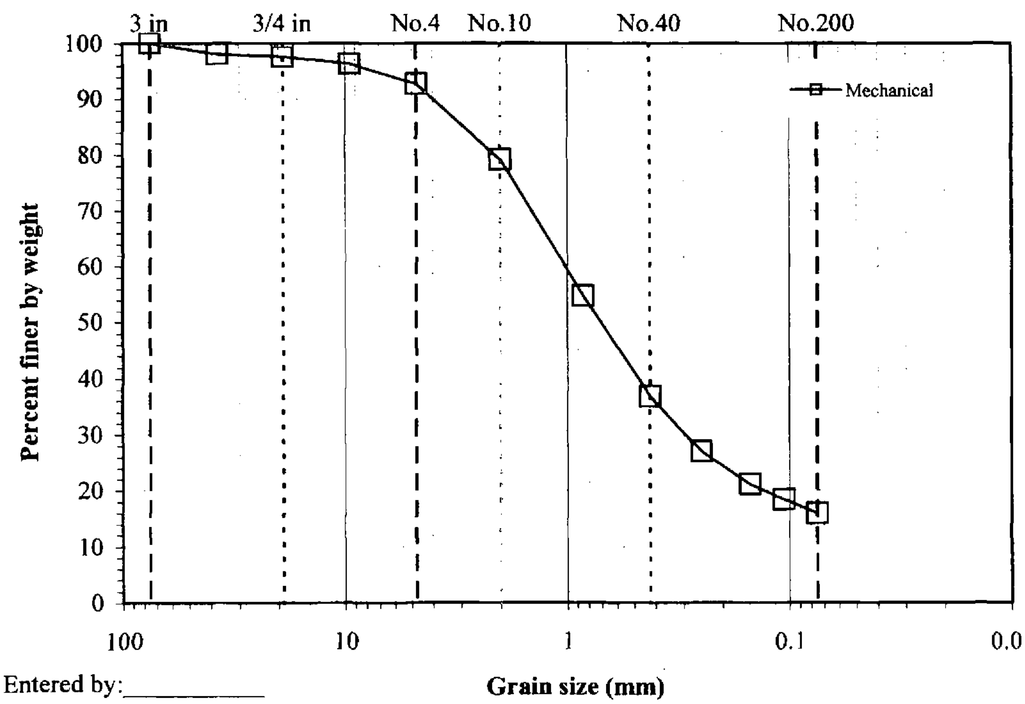
Project: CS Mining Existing Facility Expansion
No: 01640-001 (II)
Location: Milford, UT
Date: 3/19/2013
By: BRR

Boring No.: TP-8
Sample:
Depth: 3-4'
Description: Brown silty sand

Split:	Yes	
Split sieve:	3/8"	
	Moist	Dry
Total sample wt. (g):	25314.71	24389.2
+3/8" Coarse fraction (g):	914.6	904.1
-3/8" Split fraction (g):	1417.82	1364.65
Split fraction:	0.963	

Water content data	C.F.(+3/8")	S.F.(-3/8")
Moist soil + tare (g):	1144.10	1826.72
Dry soil + tare (g):	1133.50	1773.55
Tare (g):	221.95	408.90
Water content (%):	1.2	3.9

Sieve	Accum. Wt. Ret. (g)	Grain Size (mm)	Percent Finer	
8"	-	200	-	
6"	-	150	-	
4"	-	100	-	
3"	-	75	100.0	
1.5"	483.63	37.5	98.0	
3/4"	585.78	19	97.6	
3/8"	904.09	9.5	96.3	←Split
No.4	51.72	4.75	92.6	
No.10	243.89	2	79.1	
No.20	589.92	0.85	54.7	
No.40	843.07	0.425	36.8	
No.60	983.22	0.25	26.9	
No.100	1065.02	0.15	21.1	
No.140	1103.94	0.106	18.4	
No.200	1140.13	0.075	15.8	



Gravel (%): 7.4
Sand (%): 76.8
Fines (%): 15.8

Entered by:__________
Reviewed:__________

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Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis

(ASTM D6913)

IGES

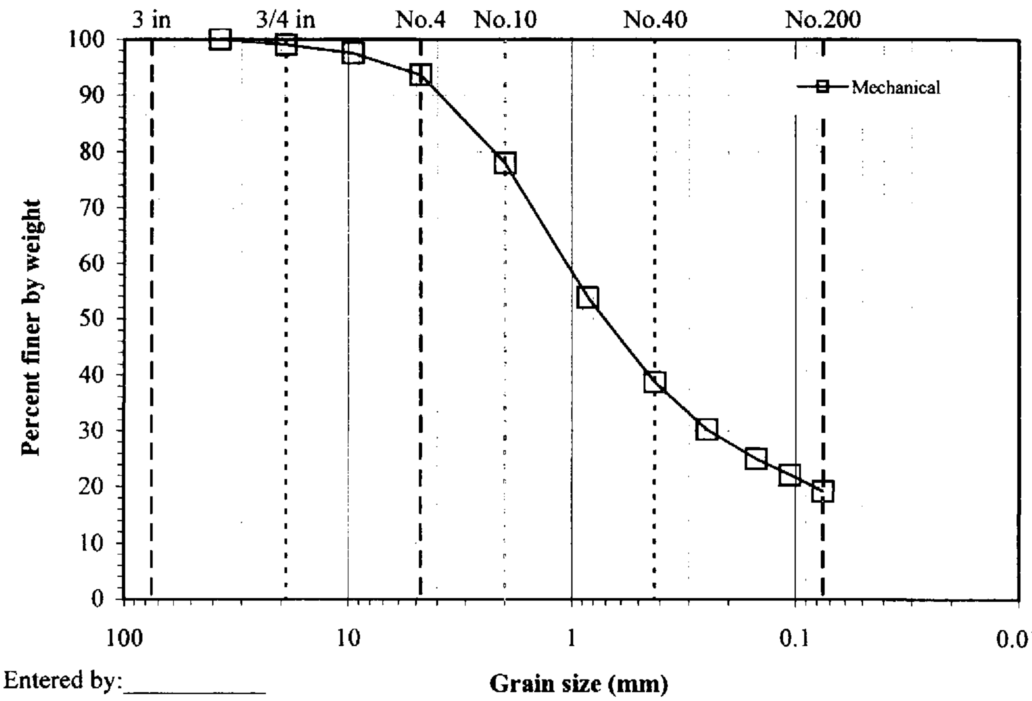
Project: CS Mining Existing Facility Expansion
No: 01640-001 (II)
Location: Milford, UT
Date: 3/19/2013
By: BRR

Boring No.: TP-9
Sample:
Depth: 3-4'
Description: Brown silty sand

	Moist	Dry
Split:	Yes	
Split sieve:	3/8"	
Total sample wt. (g):	23782.06	22671.6
+3/8" Coarse fraction (g):	573.16	564.2
-3/8" Split fraction (g):	1068.84	1018.11
Split fraction:	0.975	

Water content data	C.F.(+3/8")	S.F.(-3/8")
Moist soil + tare (g):	701.07	1477.80
Dry soil + tare (g):	692.15	1427.07
Tare (g):	127.89	408.96
Water content (%):	1.6	5.0

Sieve	Accum. Wt. Ret. (g)	Grain Size (mm)	Percent Finer	
8"	-	200	-	
6"	-	150	-	
4"	-	100	-	
3"	-	75	-	
1.5"	-	37.5	100.0	
3/4"	217.12	19	99.0	
3/8"	564.24	9.5	97.5	←Split
No.4	40.49	4.75	93.6	
No.10	204.90	2	77.9	
No.20	456.22	0.85	53.8	
No.40	614.42	0.425	38.7	
No.60	701.93	0.25	30.3	
No.100	757.61	0.15	24.9	
No.140	787.21	0.106	22.1	
No.200	817.63	0.075	19.2	



Gravel (%): 6.4
Sand (%): 74.4
Fines (%): 19.2

Entered by:__________
Reviewed:__________

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Particle-Size Analysis of Soils *with hydrometer*

(ASTM D422)

IGES

Project: **CS Mining Existing Facility Expansion**
No: **01640-001 (II)**
Location: Milford, UT
Date: 3/19/2013
By: BRR

Boring No.: **Tailings Beach**
Sample: **1**
Depth: **Surface**
Description: Grey silty sand

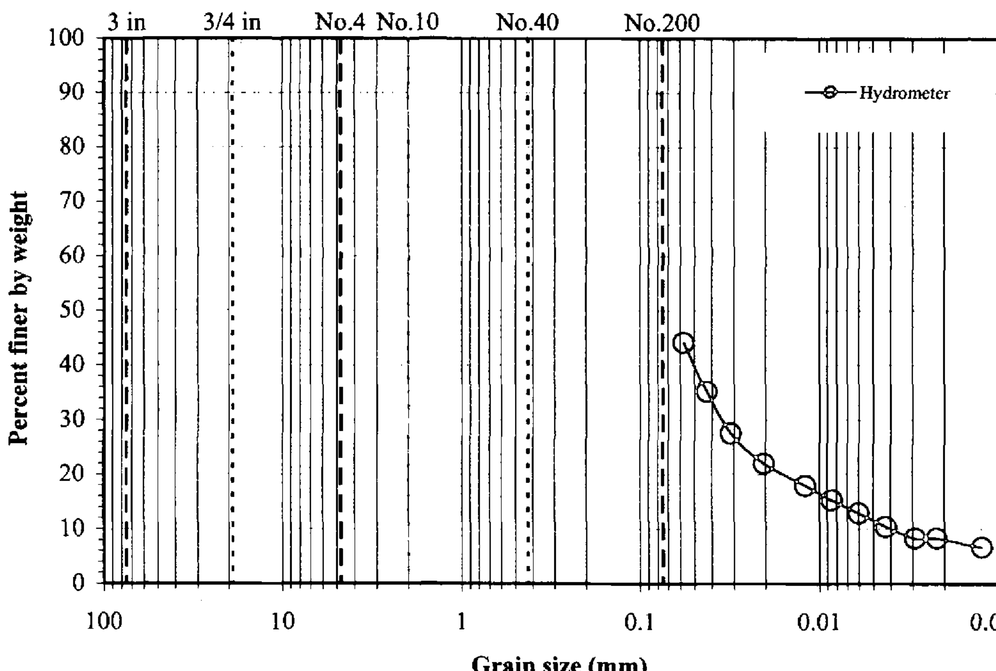
Split sieve:	No	
	Moist	Dry
Total sample wt. (g):	66.9	66.37
		0.00
		0.00
Hydrometer fraction (g):	66.90	66.37
	1.000	

Water content data	C.F.(+)	S.F.(-)	Hyd.(-No.10)
Moist soil + tare (g):	-	66.23	66.23
Dry soil + tare (g):	-	65.88	65.88
Tare (g):	-	21.93	21.93
Water content (%):	0.00	0.80	0.80

Hydrometer data				
Hyd. split:	No.10		Slope:	-0.1641
			Intercept:	16.3
Gs:	3.134	Determined	α:	0.91
Bulb No.	2		Hyd. fraction:	100.00
Dispersion period (min):	15		Dispersion device:	Air-jet

Sieve	Accum. Wt. Ret. (g)	Grain Size (mm)	Percent Finer
8"	-	200	-
6"	-	150	-
4"	-	100	-
3"	-	75	-
1.5"	-	37.5	-
3/4"	-	19	-
3/8"	-	9.5	-
No.4	-	4.75	-
No.10	-	2	-
No.20	-	0.85	-
No.40	-	0.425	-
No.60	-	0.25	-
No.100	-	0.15	-
No.140	-	0.106	-
No.200	-	0.075	-

Elapsed time (min)	Temp. (°C)	Hydrometer Reading	Grain Size (mm)	% Soil in Suspension
0.5	14.8	38	0.05747	44.08
1	14.8	31.5	0.04274	35.13
2	14.8	26	0.03142	27.55
5	14.8	22	0.02041	22.04
15	15	19	0.01198	17.98
30	15.4	17	0.00853	15.36
60	16.3	15	0.00604	12.92
120	17.1	13	0.00428	10.45
250	18.9	11	0.00293	8.32
420	20.8	10.5	0.00221	8.30
1440	18.2	10	0.00124	6.70



Entered by:__________

Reviewed:__________

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Particle-Size Analysis of Soils *with hydrometer*

(ASTM D422)

IGES

Project: CS Mining Existing Facility Expansion
No: 01640-001 (II)
Location: Milford, UT
Date: 3/19/2013
By: BRR

Boring No.: Tailngs Beach
Sample: 3
Depth: Surface
Description: Grey silty sand

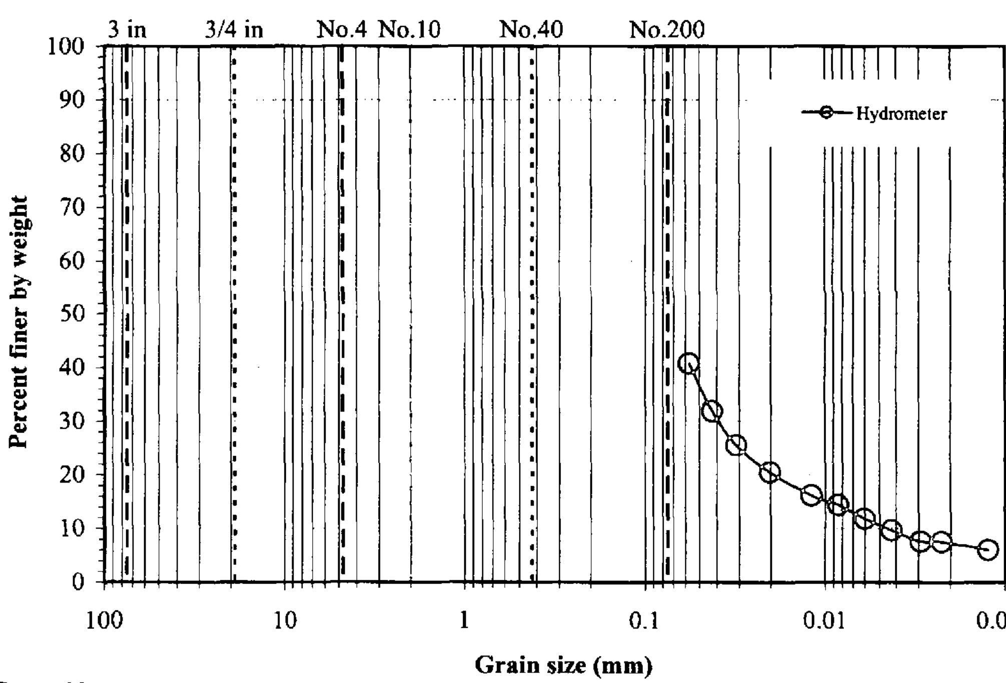
Split sieve:	No	
	Moist	Dry
Total sample wt. (g):	73.33	72.37
		0.00
		0.00
Hydrometer fraction (g):	73.33	72.37
	1.000	

Water content data	C.F.(+)	S.F.(-)	Hyd.(-No.10)
Moist soil + tare (g):	-	58.09	58.09
Dry soil + tare (g):	-	57.61	57.61
Tare (g):	-	21.55	21.55
Water content (%):	0.00	1.33	1.33

Hydrometer data				
			Slope:	-0.1641
Hyd. split:	No.10		Intercept:	16.3
Gs:	3.134	Determined	α:	0.91
Bulb No.	2		Hyd. fraction:	100.00
Dispersion period (min):	15		Dispersion device:	Air-jet

Sieve	Accum. Wt. Ret. (g)	Grain Size (mm)	Percent Finer
8"	-	200	-
6"	-	150	-
4"	-	100	-
3"	-	75	-
1.5"	-	37.5	-
3/4"	-	19	-
3/8"	-	9.5	-
No.4	-	4.75	-
No.10	-	2	-
No.20	-	0.85	-
No.40	-	0.425	-
No.60	-	0.25	-
No.100	-	0.15	-
No.140	-	0.106	-
No.200	-	0.075	-

Elapsed time (min)	Temp. (°C)	Hydrometer Reading	Grain Size (mm)	% Soil in Suspension
0.5	15.6	38	0.05689	40.69
1	15.6	31	0.04246	31.84
2	15.6	26	0.03111	25.52
5	15.6	22	0.02020	20.47
15	15.9	18.5	0.01188	16.14
30	16.4	17	0.00843	14.41
60	16.5	15	0.00602	11.91
120	17.5	13	0.00425	9.71
250	19	11	0.00293	7.66
411	20.7	10.5	0.00224	7.58
1440	18.2	10	0.00124	6.14



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Particle-Size Analysis of Soils *with hydrometer*

(ASTM D422)

IGES

Project: CS Mining Existing Facility Expansion
No: 01640-001 (II)
Location: Milford, UT
Date: 3/25/2013
By: BRR

Boring No.: Tailings Beach
Sample: 5
Depth: Surface
Description: Grey silty sand

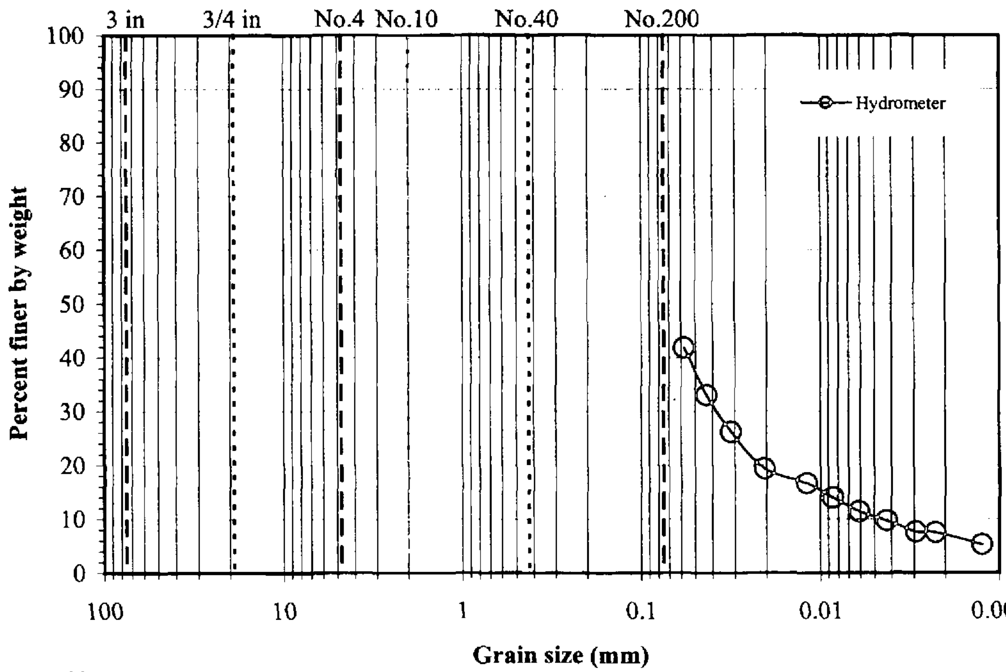
Split sieve:	No	
	Moist	Dry
Total sample wt. (g):	67.55	67.09
		0.00
		0.00
Hydrometer fraction (g):	67.55	67.09
	1.000	

Water content data	C.F.(+)	S.F.(-)	Hyd.(-No.10)
Moist soil + tare (g):	-	55.79	55.79
Dry soil + tare (g):	-	55.56	55.56
Tare (g):	-	21.72	21.72
Water content (%):	0.00	0.68	0.68

Hydrometer data				
Hyd. split:	No.10		Slope:	-0.1641
			Intercept:	16.3
Gs:	3.134	Determined	α:	0.91
Bulb No.	2		Hyd. fraction:	100.00
Dispersion period (min):	15		Dispersion device:	Air-jet

Sieve	Accum. Wt. Ret. (g)	Grain Size (mm)	Percent Finer
8"	-	200	-
6"	-	150	-
4"	-	100	-
3"	-	75	-
1.5"	-	37.5	-
3/4"	-	19	-
3/8"	-	9.5	-
No.4	-	4.75	-
No.10	-	2	-
No.20	-	0.85	-
No.40	-	0.425	-
No.60	-	0.25	-
No.100	-	0.15	-
No.140	-	0.106	-
No.200	-	0.075	-

Elapsed time (min)	Temp. (°C)	Hydrometer Reading	Grain Size (mm)	% Soil in Suspension
0.5	15.5	36.5	0.05766	41.81
1	15.5	30	0.04283	32.95
2	15.5	25	0.03136	26.13
5	15.5	20	0.02049	19.32
15	15.6	18	0.01196	16.63
30	15.9	16	0.00853	14.01
60	16.4	14	0.00607	11.45
120	17.4	12.5	0.00427	9.76
250	19.1	10.5	0.00293	7.62
403	20.8	10	0.00227	7.53
1440	18.2	9	0.00125	5.26



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Particle-Size Analysis of Soils *with hydrometer*

(ASTM D422)

IGES

Project: CS Mining Existing Facility Expansion
No: 01640-001 (II)
Location: Milford, UT
Date: 3/19/2013
By: BRR

Boring No.: Tailings Beach
Sample: 7
Depth: Surface
Description: Grey silty sand

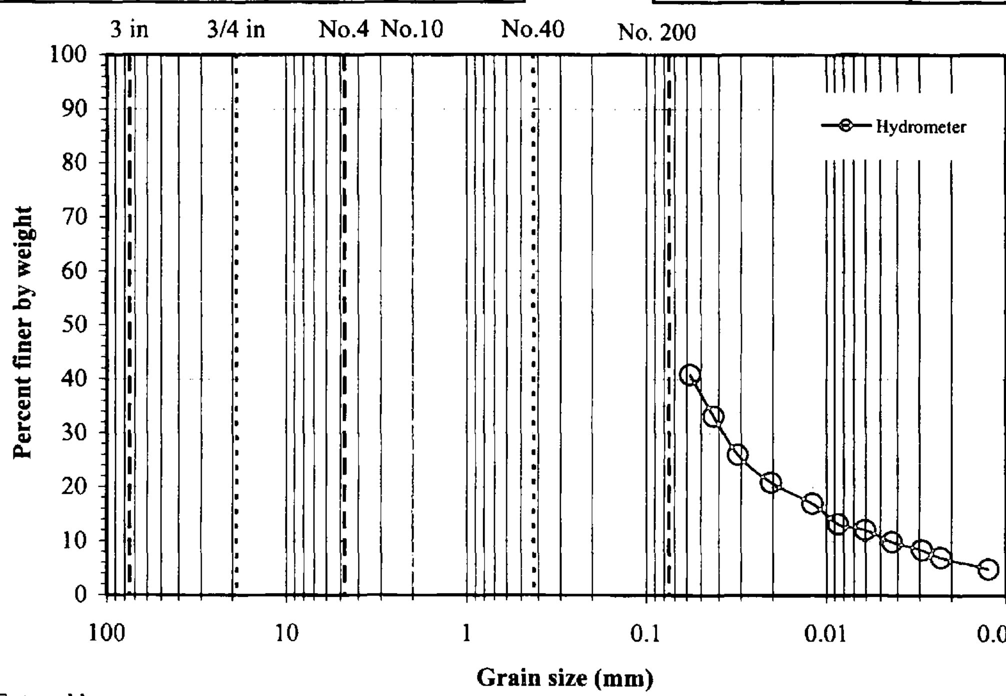
Split sieve:	No	
	Moist	Dry
Total sample wt. (g):	71.3	70.81
		0.00
		0.00
Hydrometer fraction (g):	71.30	70.81
	1.000	

Water content data	C.F.(+)	S.F.(-)	Hyd.(-No.10)
Moist soil + tare (g):	-	56.65	56.65
Dry soil + tare (g):	-	56.41	56.41
Tare (g):	-	21.84	21.84
Water content (%):	0.00	0.69	0.69

Hydrometer data				
			Slope:	-0.1641
Hyd. split:	No.10		Intercept:	16.3
Gs:	3.134	Determined	α:	0.91
Bulb No.	2		Hyd. fraction:	100.00
Dispersion period (min):	15		Dispersion device:	Air-jet

Sieve	Accum. Wt. Ret. (g)	Grain Size (mm)	Percent Finer
8"	-	200	-
6"	-	150	-
4"	-	100	-
3"	-	75	-
1.5"	-	37.5	-
3/4"	-	19	-
3/8"	-	9.5	-
No.4	-	4.75	-
No.10	-	2	-
No.20	-	0.85	-
No.40	-	0.425	-
No.60	-	0.25	-
No.100	-	0.15	-
No.140	-	0.106	-
No.200	-	0.075	-

Elapsed time (min)	Temp. (°C)	Hydrometer Reading	Grain Size (mm)	% Soil in Suspension
0.5	15.4	37.5	0.05728	40.87
1	15.4	31.5	0.04242	33.12
2	15.4	26	0.03119	26.02
5	15.4	22	0.02026	20.86
15	15.5	19	0.01190	17.01
30	15.7	16	0.00855	13.21
60	16.3	15	0.00604	12.11
120	17.5	13	0.00425	9.92
250	19.1	11.5	0.00291	8.51
397	20.7	10	0.00229	7.10
1440	18.1	9	0.00125	4.95



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Specific Gravity of Soil Solids by Water Pycnometer

(ASTM D854)

IGES

Project: CS Mining Existing Facility Expansion
No: 01640-001 (II)
Location: Milford, UT
Date: 3/21/2013
By: JDF

Drill hole / Sample:	Tailings Beach					
Sample No:	Bucket					
Depth (ft)	Surface					
Engineering Classification	Not req.					
Method	A					
Material passing No. 4 seive, P (%)	100					
Pycnometer No.	3					
Mass of pycnometer (g)	170.57					
Mass of pycnometer, soil, and water, $M_{\rho ws,t}$ (g)	704.54					
Temperature, T_t (°C)	19.0					
Mass of pycnometer and water at test temperature, $M_{pw,t}$ (g)	669.47					
Mass of tare + dry soil (g)	498.27					
Mass of tare (g)	446.76					
Mass of soil, M_s (g)	51.51					
Specific gravity of soil solids at test temperature, G_t	3.133					
Temperature coefficient, K	1.00020					
Specific gravity of soil solids at 20°C, $G_{20°C}$	3.134					
Apparent specific gravity of solids retained on No. 4, $G_{1@20°C}$						
Average specific gravity at 20°C, $G_{avg\ @20°C}$						

Tested by:__________

Reviewed by:__________

Laboratory Compaction Characteristics of Soil

(ASTM D698 / D1557)

IGES

Project: CS Mining Existing Facility Expansion
No: 01640-001 (II)
Location: Milford, UT
Date: 3/13/2013
By: BRR

Boring No.: TP-3
Sample: Combined Samples
Depth: 1-3'
Sample Description: Brown silty sand with gravel
Engineering Classification: Not requested
As-received water content (%): Not requested

Method: ASTM D698 C
Mold Id. Inc 7
Mold volume (ft^3): 0.0752

Preparation method: Moist
Rammer: Mechanical-sector face
Rock Correction: Yes * See results below
Percent fraction retained, Pc (%) 21.2
Percent fraction passing, Pf (%) 78.8

Optimum water content (%): 10.3
Maximum dry unit weight (pcf): 127.5

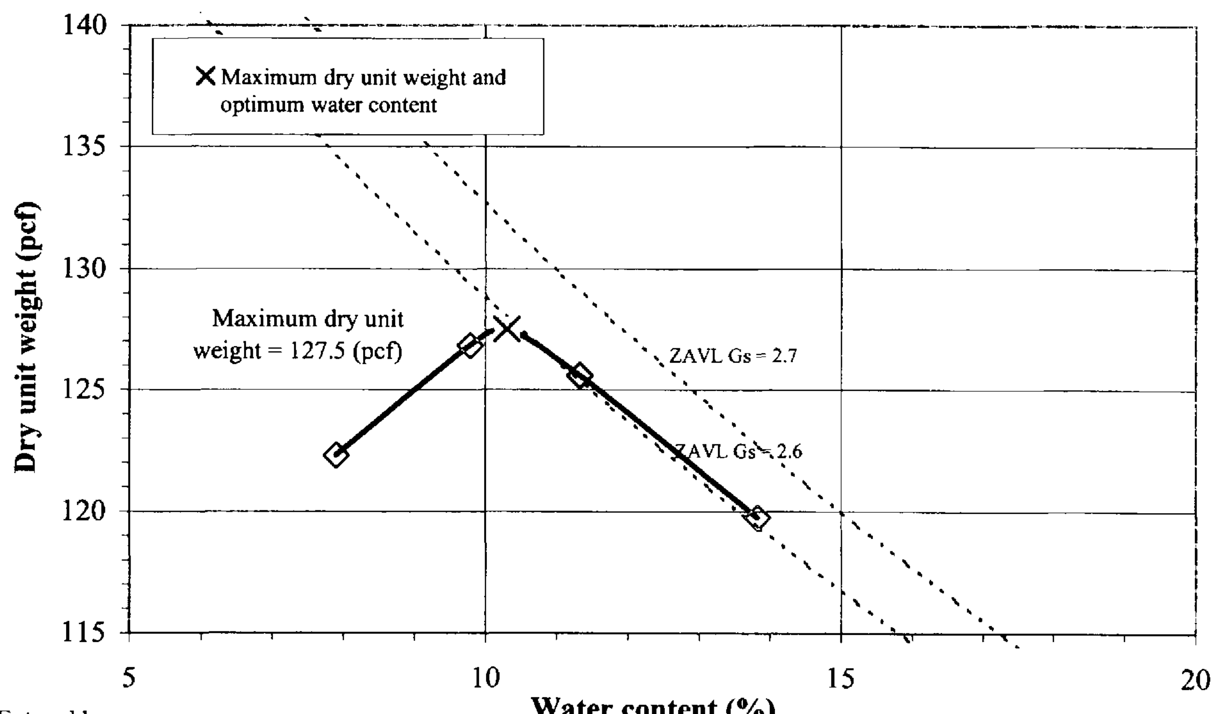
Point Number	+2%	+4%	+6%	+8%				
Wt. Sample + Mold (g)	11036.5	11283.9	11304.1	11184.7				
Wt. of Mold (g)	6537.5	6537.5	6537.5	6537.5				
Wet Unit Wt., γ_m (pcf)	132.0	139.2	139.8	136.3				
Wet Soil + Tare (g)	1497.90	1501.86	1439.76	1431.35				
Dry Soil + Tare (g)	1422.13	1409.40	1338.74	1314.21				
Tare (g)	462.95	464.17	446.58	467.02				
Water Content, w (%)	**7.9**	**9.8**	**11.3**	**13.8**				
Dry Unit Wt., γ_d (pcf)	**122.3**	**126.8**	**125.6**	**119.8**				

***Correction of Unit Weight and Water Content for Soils Containing Oversize Particles**

(ASTM D4718)

Corrected water content (%): 8.4
Corrected dry unit weight (pcf): 134.0

Oversized fraction, +3/4-in. (%): 21.2
Water content, +3/4-in. (%): 1.6
Sieve for oversized fraction: 3/4-in.
Bulk specific gravity, Gs: 2.65 Assumed



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Laboratory Compaction Characteristics of Soil

(ASTM D698 / D1557)

IGES

Project: CS Mining Existing Facility Expansion
No: 01640-001 (II)
Location: Milford, UT
Date: 3/14/2013
By: BRR

Boring No.: TP-4
Sample:
Depth: 5-6'
Sample Description: Light brown clayey sand with gravel
Engineering Classification: Not requested
As-received water content (%): Not requested

Method: ASTM D698 B
Mold Id. Inc 3
Mold volume (ft^3): 0.0332

Preparation method: Moist
Rammer: Mechanical-circular face
Rock Correction: Yes * See results below
Percent fraction retained, Pc (%) 5.0
Percent fraction passing, Pf (%) 95.0

Optimum water content (%): 13.6
Maximum dry unit weight (pcf): 120.7

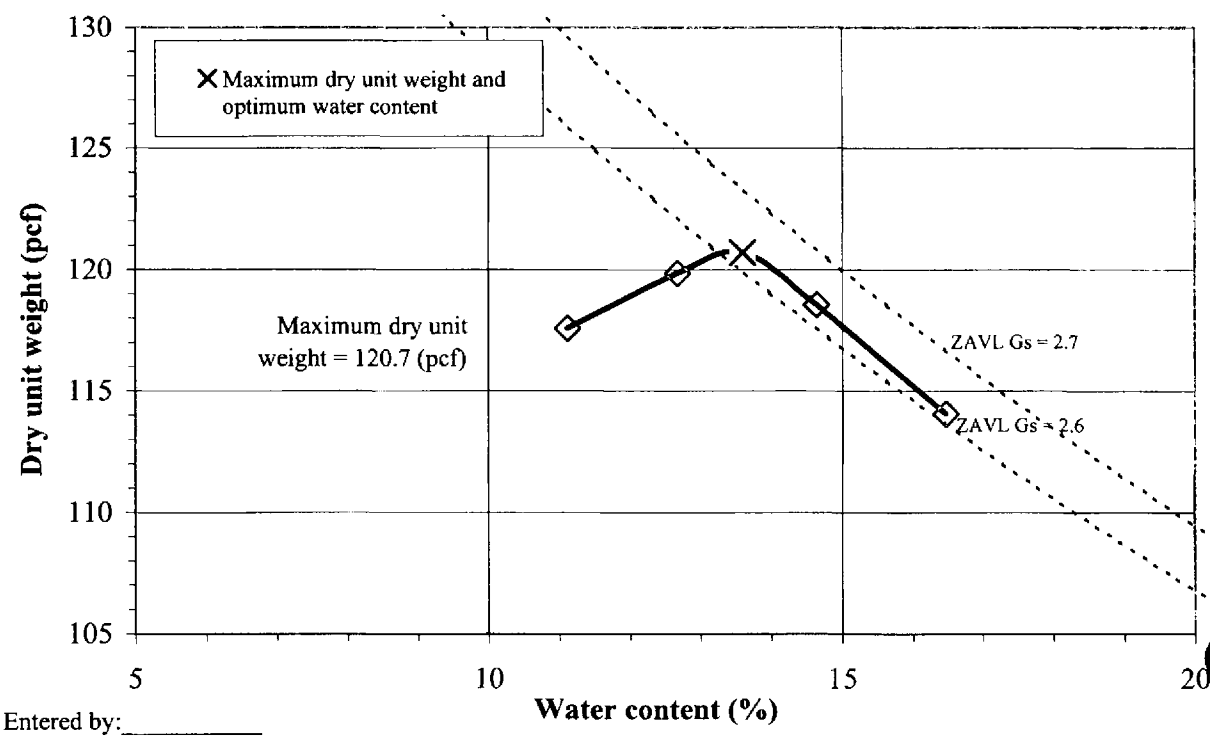
Point Number	+6%	+8%	+10%	12%				
Wt. Sample + Mold (g)	6142.0	6208.0	6221.0	6175.0				
Wt. of Mold (g)	4172.7	4172.7	4172.7	4172.7				
Wet Unit Wt., γ_m (pcf)	130.7	135.0	135.9	132.9				
Wet Soil + Tare (g)	776.60	818.73	849.93	786.20				
Dry Soil + Tare (g)	713.04	741.04	757.80	692.40				
Tare (g)	141.35	128.10	128.25	122.74				
Water Content, w (%)	**11.1**	12.7	**14.6**	16.5				
Dry Unit Wt., γ_d (pcf)	**117.6**	119.9	**118.6**	114.1				

***Correction of Unit Weight and Water Content for Soils Containing Oversize Particles**

(ASTM D4718)

Corrected water content (%): 13.0
Corrected dry unit weight (pcf): 122.4

Oversized fraction, +3/8-in. (%): 5.0
Water content, +3/8-in. (%): 1.7
Sieve for oversized fraction: 3/8-in.
Bulk specific gravity, Gs: 2.65 Assumed



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Laboratory Compaction Characteristics of Soil

(ASTM D698 / D1557)

IGES

Project: **CS Mining Existing Facility Expansion**
No: **01640-001 (II)**
Location: Milford, UT
Date: 3/14/2013
By: BRR

Boring No.: **TP-5**
Sample: **Combined Samples**
Depth: **3-4' & 6'**
Sample Description: Brown silty sand with gravel
Engineering Classification: Not requested
As-received water content (%): Not requested

Method: ASTM D698 C
Mold Id. Inc 4
Mold volume (ft^3): 0.0751

Preparation method: Moist
Rammer: Mechanical-sector face
Rock Correction: Yes * See results below
Percent fraction retained, Pc (%) 9.9
Percent fraction passing, Pf (%) 90.1

Optimum water content (%): **13.2**
Maximum dry unit weight (pcf): **115.7**

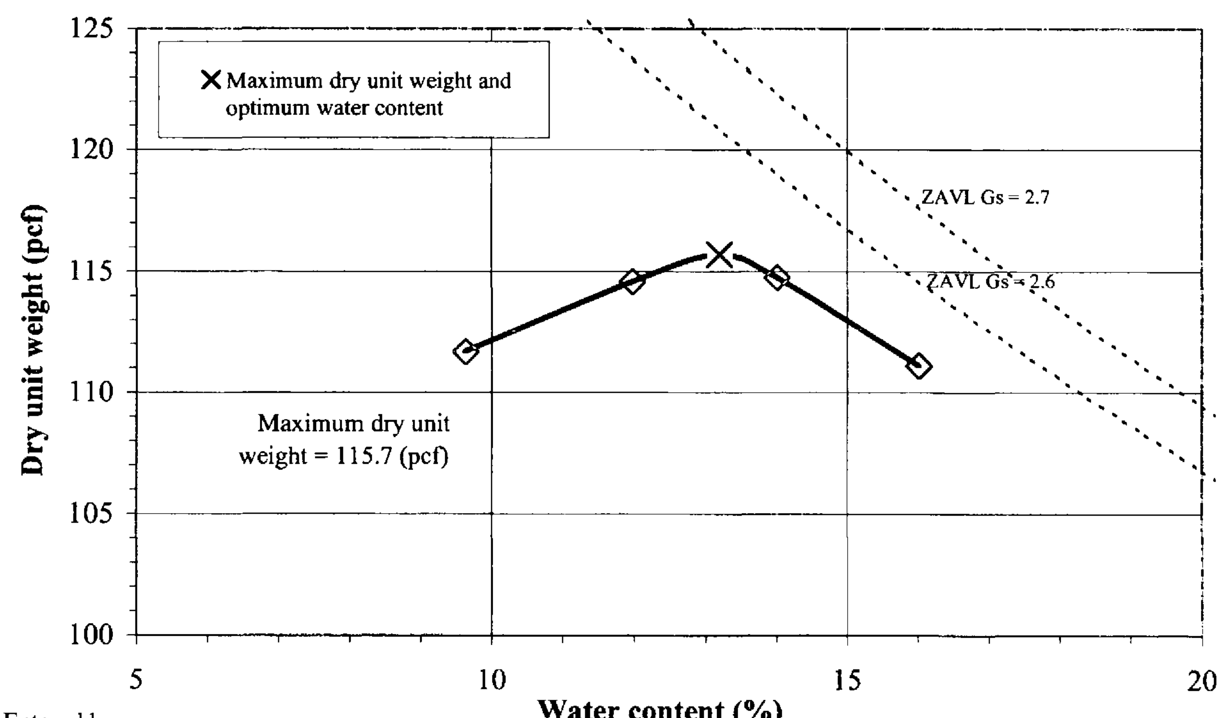
Point Number	+4%	+6%	+8%	+2%				
Wt. Sample + Mold (g)	9974.8	10060.5	9994.8	9774.5				
Wt. of Mold (g)	5603.6	5603.6	5603.6	5603.6				
Wet Unit Wt., γ_m (pcf)	128.3	130.8	128.9	122.4				
Wet Soil + Tare (g)	1366.32	1396.01	1684.65	1302.86				
Dry Soil + Tare (g)	1263.82	1263.24	1516.30	1229.55				
Tare (g)	408.01	315.59	465.15	468.01				
Water Content, w (%)	**12.0**	14.0	**16.0**	9.6				
Dry Unit Wt., γ_d (pcf)	**114.6**	114.7	**111.1**	111.7				

*Correction of Unit Weight and Water Content for Soils Containing Oversize Particles

(ASTM D4718)

Corrected water content (%): **12.1**
Corrected dry unit weight (pcf): **119.2**

Oversized fraction, +3/4-in. (%): 9.9
Water content, +3/4-in. (%): 2.3
Sieve for oversized fraction: 3/4-in.
Bulk specific gravity, Gs: 2.65 Assumed



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Laboratory Compaction Characteristics of Soil

(ASTM D698 / D1557)

IGES

Project: CS Mining Existing Facility Expansion
No: 01640-001 (II)
Location: Milford, UT
Date: 3/13/2013
By: BRR

Boring No.: TP-6
Sample: Combined Samples
Depth: 2-3' & 5-6'
Sample Description: Brown silty sand with gravel
Engineering Classification: Not requested
As-received water content (%): Not requested

Method: ASTM D698 C
Mold Id. Inc 4
Mold volume (ft^3): 0.0751

Preparation method: Moist
Rammer: Mechanical-sector face
Rock Correction: Yes * See results below
Percent fraction retained, Pc (%) 17.6
Percent fraction passing, Pf (%) 82.4

Optimum water content (%): 14.5
Maximum dry unit weight (pcf): 115.5

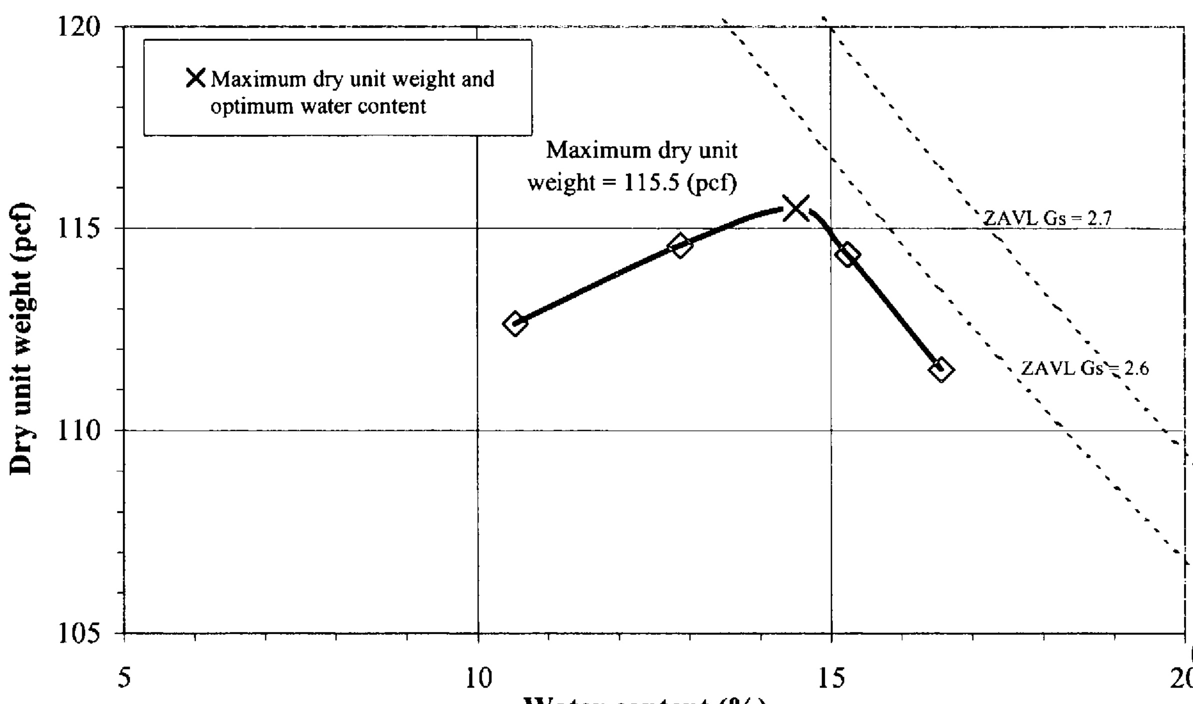
Point Number	+4%	+6%	+8%	+10%				
Wt. Sample + Mold (g)	9845.5	10009.5	10093.2	10032.2				
Wt. of Mold (g)	5603.7	5603.7	5603.7	5603.7				
Wet Unit Wt., γ_m (pcf)	124.5	129.3	131.8	130.0				
Wet Soil + Tare (g)	1254.57	1281.81	1467.16	1315.03				
Dry Soil + Tare (g)	1164.52	1171.07	1325.15	1172.12				
Tare (g)	309.79	310.45	393.09	309.56				
Water Content, w (%)	**10.5**	12.9	**15.2**	16.6				
Dry Unit Wt., γ_d (pcf)	**112.6**	114.6	**114.4**	111.5				

***Correction of Unit Weight and Water Content for Soils Containing Oversize Particles**

(ASTM D4718)

Corrected water content (%): 12.4
Corrected dry unit weight (pcf): 122.0

Oversized fraction, +3/4-in. (%): 17.6
Water content, +3/4-in. (%): 2.5
Sieve for oversized fraction: 3/4-in.
Bulk specific gravity, Gs: 2.65 Assumed



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Laboratory Compaction Characteristics of Soil

(ASTM D698 / D1557)

IGES

Project: CS Mining Existing Facility Expansion
No: 01640-001 (II)
Location: Milford, UT
Date: 3/14/2013
By: BRR

Boring No.: TP-7
Sample:
Depth: 2-3'
Sample Description: Brown sand with silt
Engineering Classification: Not requested
As-received water content (%): Not requested

Method: ASTM D698 B
Mold Id. Inc 2
Mold volume (ft^3): 0.0332

Preparation method: Moist
Rammer: Mechanical-circular face
Rock Correction: Yes * See results below
Percent fraction retained, Pc (%) 5.4
Percent fraction passing, Pf (%) 94.6

Optimum water content (%): 12.8
Maximum dry unit weight (pcf): 118.3

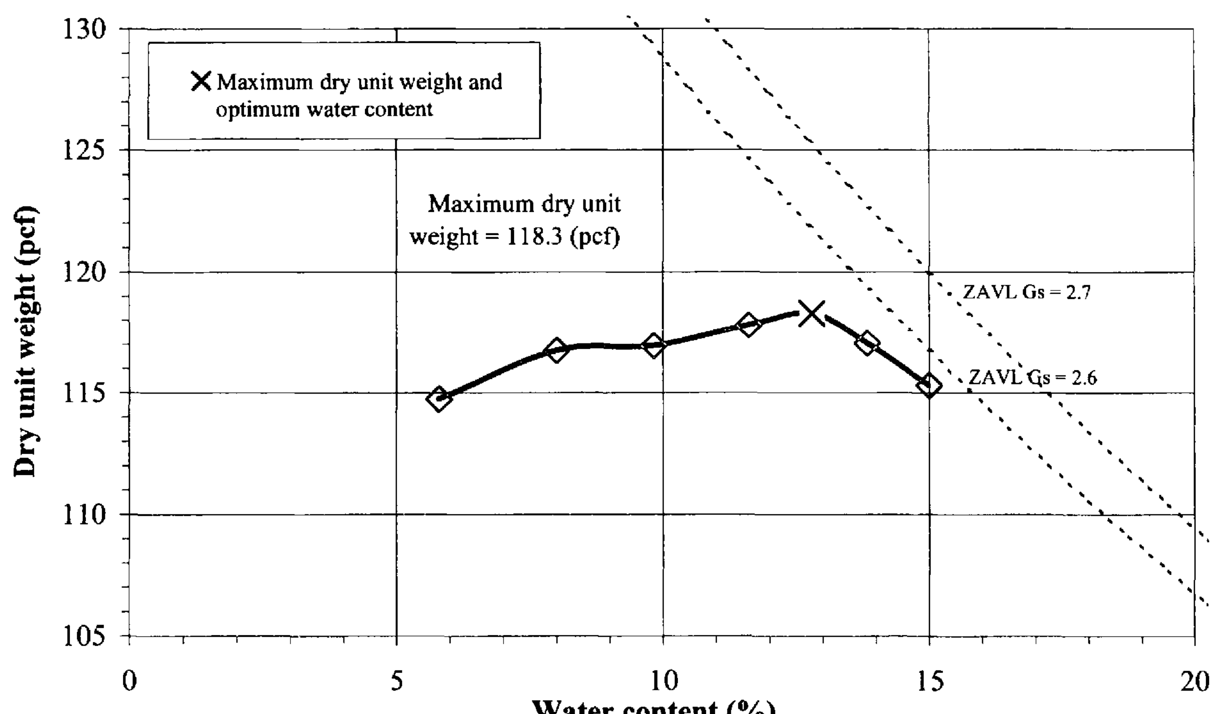
Point Number	+4%	+6%	+2%	+8%	+10%	+12%		
Wt. Sample + Mold (g)	6062.8	6098.2	5992.0	6144.3	6170.8	6161.2		
Wt. of Mold (g)	4163	4163	4163	4163	4163	4163		
Wet Unit Wt., γ_m (pcf)	126.1	128.4	121.4	131.5	133.2	132.6		
Wet Soil + Tare (g)	777.61	707.66	718.70	808.25	842.04	617.74		
Dry Soil + Tare (g)	729.36	655.45	686.13	737.36	755.10	553.87		
Tare (g)	126.14	123.99	123.46	127.14	127.00	127.76		
Water Content, w (%)	**8.0**	**9.8**	**5.8**	**11.6**	**13.8**	**15.0**		
Dry Unit Wt., γ_d (pcf)	**116.7**	**116.9**	**114.7**	**117.8**	**117.0**	**115.3**		

***Correction of Unit Weight and Water Content for Soils Containing Oversize Particles**

(ASTM D4718)

Corrected water content (%): 12.2
Corrected dry unit weight (pcf): 120.1

Oversized fraction, +3/8-in. (%): 5.4
Water content, +3/8-in. (%): 1.7
Sieve for oversized fraction: 3/8-in.
Bulk specific gravity, Gs: 2.65 Assumed



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Laboratory Compaction Characteristics of Soil

(ASTM D698 / D1557)

IGES

Project: **CS Mining Existing Facility Expansion**
No: **01640-001 (II)**
Location: Milford, UT
Date: 3/14/2013
By: BRR

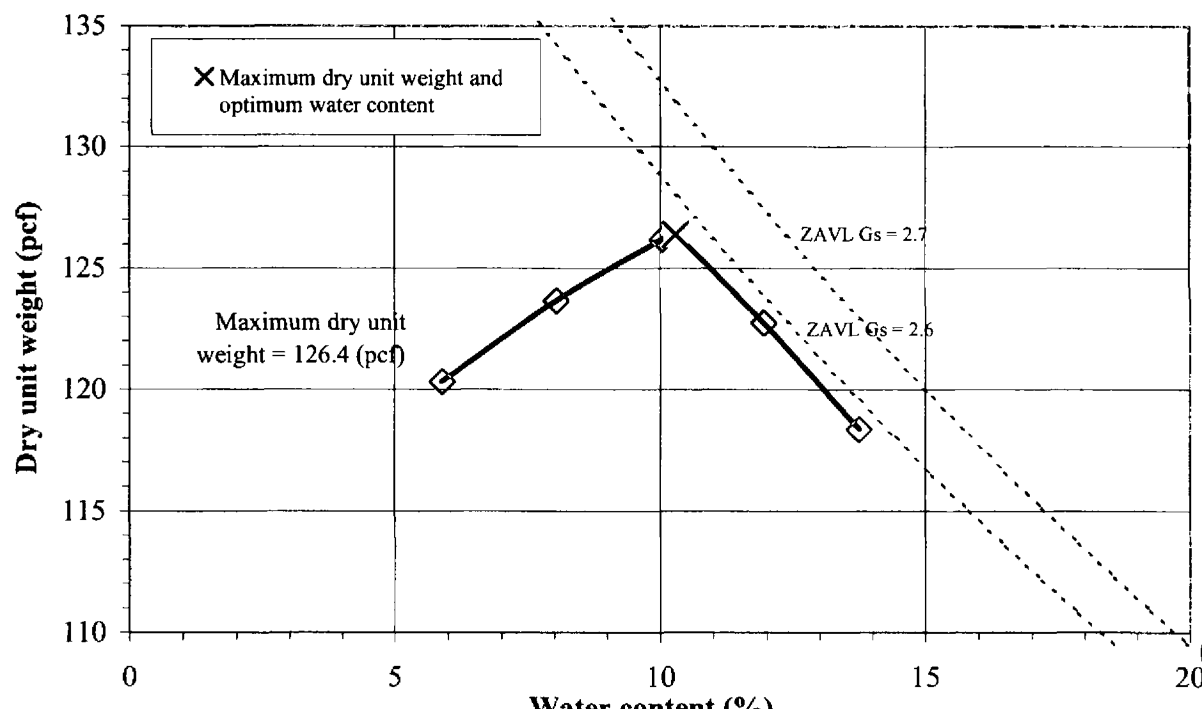
Boring No.: **TP-8**
Sample:
Depth: **3-4'**
Sample Description: Brown silty sand
Engineering Classification: Not requested
As-received water content (%): Not requested

Method: ASTM D698 B
Mold Id. Inc 1
Mold volume (ft^3): 0.0333

Preparation method: Moist
Rammer: Mechanical-circular face
Rock Correction: No

Optimum water content (%): **10.3**
Maximum dry unit weight (pcf): **126.4**

Point Number	+4%	+6%	+8%	+2%	+10%			
Wt. Sample + Mold (g)	6265.9	6345.6	6323.1	6172.5	6281.8			
Wt. of Mold (g)	4248.2	4248.2	4248.2	4248.2	4248.2			
Wet Unit Wt., γ_m (pcf)	133.6	138.9	137.4	127.4	134.7			
Wet Soil + Tare (g)	787.32	752.37	774.06	712.33	679.61			
Dry Soil + Tare (g)	738.15	695.40	706.39	679.83	612.83			
Tare (g)	126.70	128.46	139.72	127.59	127.35			
Water Content, w (%)	**8.0**	10.0	**11.9**	5.9	13.8			
Dry Unit Wt., γ_d (pcf)	**123.7**	126.2	**122.7**	120.3	118.4			



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Laboratory Compaction Characteristics of Soil

(ASTM D698 / D1557)

IGES

Project: CS Mining Existing Facility Expansion
No: 01640-001 (II)
Location: Milford, UT
Date: 3/14/2013
By: BRR

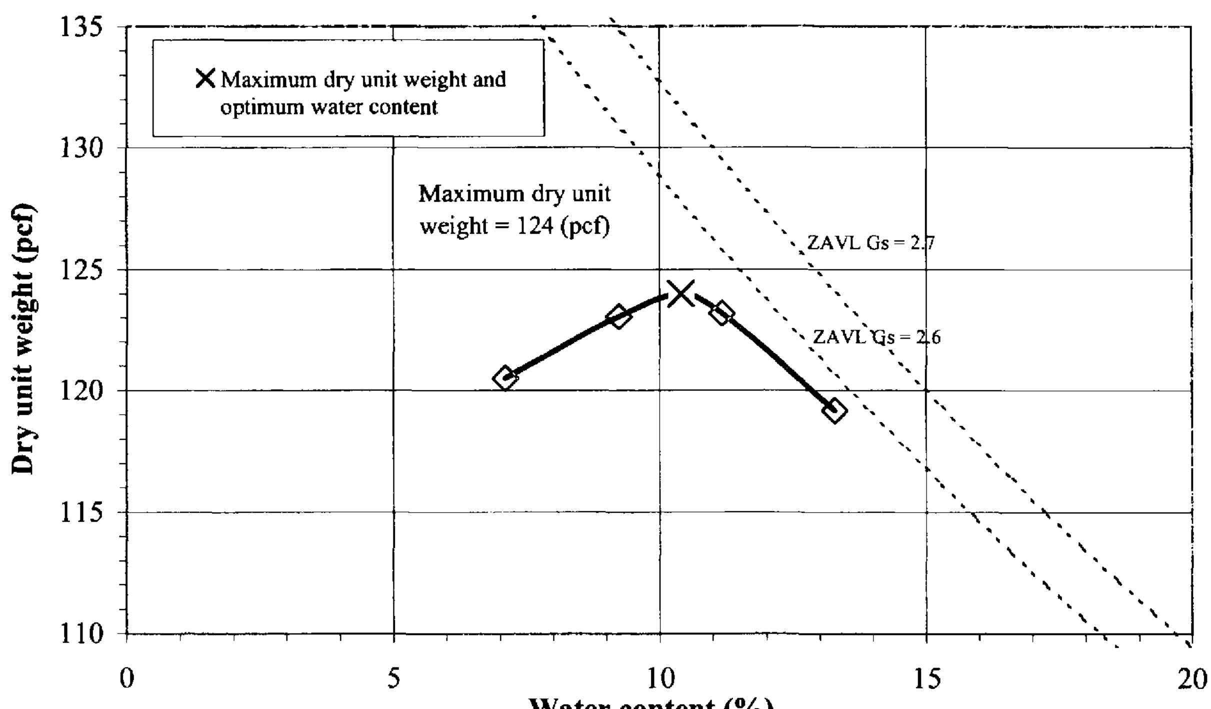
Boring No.: TP-9
Sample:
Depth: 3-4'
Sample Description: Brown silty sand
Engineering Classification: Not requested
As-received water content (%): Not requested

Method: ASTM D698 B
Mold Id. Inc 2
Mold volume (ft^3): 0.0332

Preparation method: Moist
Rammer: Mechanical-circular face
Rock Correction: No

Optimum water content (%): 10.4
Maximum dry unit weight (pcf): 124

Point Number	+4%	+6%	+8%	+2%				
Wt. Sample + Mold (g)	6188.6	6226.7	6197.2	6107.8				
Wt. of Mold (g)	4163	4163	4163	4163				
Wet Unit Wt., γ_m (pcf)	134.4	137.0	135.0	129.1				
Wet Soil + Tare (g)	804.60	663.23	806.50	702.87				
Dry Soil + Tare (g)	747.35	608.96	726.45	664.48				
Tare (g)	127.56	123.03	123.82	124.00				
Water Content, w (%)	**9.2**	**11.2**	**13.3**	**7.1**				
Dry Unit Wt., γ_d (pcf)	**123.1**	**123.2**	**119.2**	**120.5**				



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Direct Shear Test for Soils Under Drained Conditions

(ASTM D3080)

IGES

Project: CS Mining Existing Facility Expansion
No: 01640-001 (II)
Location: Milford, UT
Date: 3/25/2013
By: JDF

Boring No.: TP-5
Sample:
Depth: 3-4' & 6'
Sample Description: Brown silty sand
Sample type: Laboratory compacted
Dry unit weight 109.9 pcf
at 15.2 (%) w
Compaction specifications: 95% of ASTM D698B

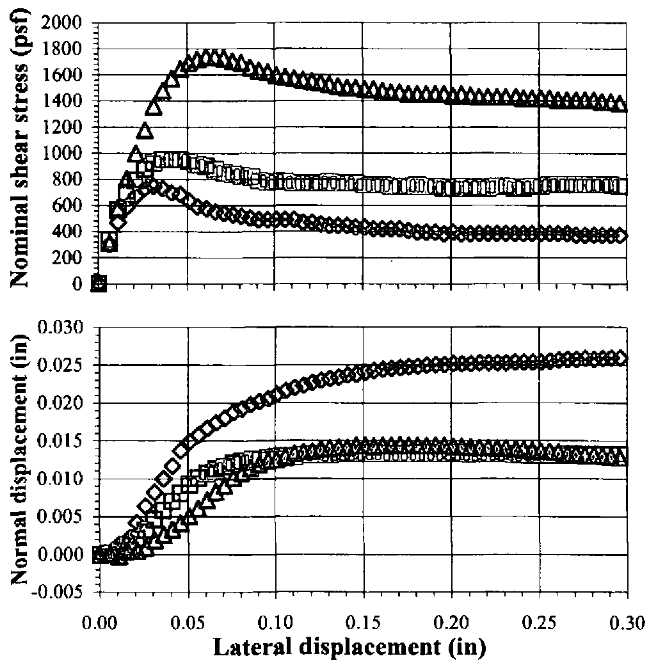
Test type: Inundated
Lateral displacement (in.): 0.3
Shear rate (in./min): 0.0200
Specific gravity, Gs: 2.65 Assumed

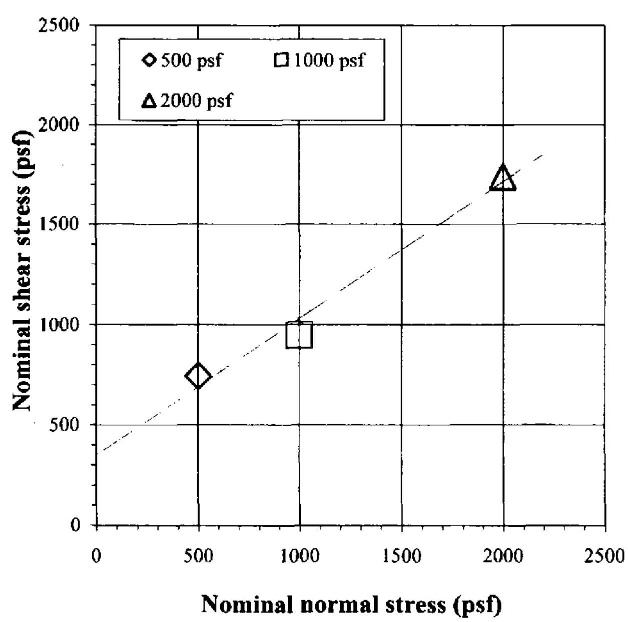
	Sample 1		Sample 2		Sample 3	
Nominal normal stress (psf)	500		1000		2000	
Peak shear stress (psf)	744		948		1740	
Lateral displacement at peak (in)	0.031		0.036		0.061	
	Initial	Pre-shear	Initial	Pre-shear	Initial	Pre-shear
Sample height (in)	1.0000	0.9908	1.0000	0.9844	1.0000	0.9833
Sample diameter (in)	2.416	2.416	2.416	2.416	2.416	2.416
Wt. rings + wet soil (g)	195.73	200.12	194.84	198.74	198.78	202.60
Wt. rings (g)	43.22	43.22	42.33	42.33	46.27	46.27
Wet soil + tare (g)	293.90	178.84	293.90	178.04	293.90	175.93
Dry soil + tare (g)	272.14	153.77	272.14	153.90	272.14	151.57
Tare (g)	128.56	21.12	128.56	22.22	128.56	20.91
Water content (%)	15.2	18.5	15.2	18.1	15.2	18.0
Dry unit weight (pcf)	110.1	111.0	110.1	111.7	110.1	111.9
Void ratio, e, for assumed Gs	0.50	0.49	0.50	0.48	0.50	0.48
Saturation (%)*	79.8	100.0	79.8	100.0	79.8	100.0

ϕ' (deg)	34
c' (psf)	348

Average of 3 samples	Initial	Pre-shear
Water content (%)	15.2	18.2
Dry unit weight (pcf)	110.1	111.5

*Pre-shear saturation set to 100% for phase calculations





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Nominal normal stress = 500 psf			Nominal normal stress = 1000 psf			Nominal normal stress = 2000 psf		
Lateral Displacement (in.)	Nominal Shear Stress (psf)	Normal Displacement (in.)	Lateral Displacement (in.)	Nominal Shear Stress (psf)	Normal Displacement (in.)	Lateral Displacement (in.)	Nominal Shear Stress (psf)	Normal Displacement (in.)
0	0	0.0000	0	0	0.0000	0	12	0.0000
0.006	300	0.0003	0.006	336	0.0002	0.006	312	0.0001
0.011	468	0.0013	0.011	564	0.0005	0.011	576	-0.0002
0.016	588	0.0020	0.016	696	0.0012	0.016	804	0.0004
0.021	672	0.0042	0.021	792	0.0021	0.021	996	0.0005
0.026	732	0.0064	0.026	876	0.0032	0.026	1176	0.0009
0.031	744	0.0082	0.031	924	0.0046	0.031	1356	0.0019
0.036	732	0.0100	0.036	948	0.0058	0.036	1476	0.0026
0.041	696	0.0117	0.041	948	0.0070	0.041	1572	0.0033
0.046	684	0.0137	0.046	948	0.0081	0.046	1644	0.0041
0.051	636	0.0149	0.051	936	0.0092	0.051	1692	0.0051
0.056	588	0.0158	0.056	912	0.0101	0.056	1716	0.0061
0.061	576	0.0167	0.061	900	0.0107	0.061	1740	0.0072
0.066	552	0.0174	0.066	876	0.0113	0.066	1740	0.0083
0.071	540	0.0180	0.071	852	0.0116	0.071	1728	0.0091
0.076	528	0.0188	0.076	840	0.0121	0.076	1704	0.0102
0.081	516	0.0193	0.081	828	0.0123	0.081	1692	0.0108
0.086	504	0.0198	0.087	816	0.0126	0.086	1656	0.0114
0.091	492	0.0202	0.091	792	0.0126	0.091	1632	0.0119
0.096	492	0.0206	0.096	780	0.0127	0.096	1620	0.0124
0.101	492	0.0211	0.101	780	0.0129	0.101	1596	0.0125
0.106	492	0.0216	0.106	780	0.0127	0.106	1584	0.0129
0.111	492	0.0220	0.111	768	0.0129	0.111	1572	0.0133
0.116	468	0.0223	0.116	768	0.0131	0.116	1560	0.0135
0.121	468	0.0227	0.121	768	0.0132	0.121	1548	0.0136
0.126	456	0.0230	0.126	768	0.0132	0.126	1536	0.0139
0.131	444	0.0232	0.131	780	0.0132	0.131	1524	0.0140
0.136	444	0.0234	0.136	768	0.0133	0.136	1512	0.0141
0.141	444	0.0237	0.141	768	0.0133	0.141	1500	0.0141
0.146	432	0.0238	0.146	768	0.0133	0.146	1500	0.0144
0.151	432	0.0241	0.151	756	0.0133	0.151	1488	0.0144
0.156	420	0.0243	0.156	756	0.0134	0.156	1488	0.0143
0.161	420	0.0245	0.161	756	0.0133	0.161	1476	0.0144
0.166	420	0.0246	0.166	744	0.0133	0.166	1464	0.0144
0.171	420	0.0247	0.171	744	0.0133	0.171	1464	0.0145
0.176	408	0.0248	0.176	744	0.0133	0.176	1452	0.0144
0.181	396	0.0249	0.181	756	0.0134	0.181	1452	0.0144
0.186	396	0.0250	0.186	744	0.0134	0.186	1452	0.0144
0.191	396	0.0251	0.191	744	0.0134	0.191	1452	0.0144
0.196	384	0.0251	0.196	732	0.0134	0.196	1452	0.0144
0.201	396	0.0252	0.201	732	0.0134	0.201	1440	0.0143
0.206	384	0.0252	0.206	744	0.0134	0.206	1452	0.0143
0.211	384	0.0252	0.211	732	0.0133	0.211	1440	0.0142
0.216	384	0.0253	0.216	732	0.0133	0.216	1428	0.0141
0.221	384	0.0253	0.221	732	0.0133	0.221	1428	0.0141
0.226	384	0.0253	0.226	744	0.0133	0.226	1428	0.0140
0.231	384	0.0253	0.231	744	0.0133	0.231	1428	0.0140
0.236	384	0.0254	0.236	732	0.0132	0.237	1428	0.0139
0.241	384	0.0254	0.241	732	0.0132	0.241	1416	0.0138
0.246	384	0.0254	0.246	744	0.0131	0.246	1416	0.0137
0.251	384	0.0254	0.251	744	0.0131	0.251	1416	0.0136
0.256	384	0.0256	0.256	756	0.0131	0.256	1416	0.0136
0.261	384	0.0257	0.261	756	0.0131	0.261	1404	0.0135
0.266	384	0.0258	0.266	756	0.0132	0.266	1404	0.0133
0.271	372	0.0258	0.271	756	0.0132	0.271	1404	0.0133
0.276	372	0.0259	0.276	756	0.0131	0.276	1404	0.0131
0.281	372	0.0258	0.281	756	0.0132	0.281	1404	0.0131
0.286	372	0.0259	0.286	756	0.0132	0.286	1392	0.0130
0.291	372	0.0260	0.291	756	0.0132	0.291	1392	0.0129
0.296	372	0.0260	0.296	744	0.0132	0.296	1380	0.0128
0.301	372	0.0261	0.301	756	0.0132	0.301	1392	0.0127

Direct Shear Test for Soils Under Drained Conditions

(ASTM D3080)

IGES

Project: CS Mining Existing Facility Expansion
No: 01640-001 (II)
Location: Milford, UT
Date: 3/25/2013
By: JDF

Boring No.: TP-8
Sample:
Depth: 3-4'
Sample Description: Brown silty sand
Sample type: Laboratory compacted
Dry unit weight 120.1 pcf
at 12.3 (%) w
Compaction specifications: 95% of ASTM D698B

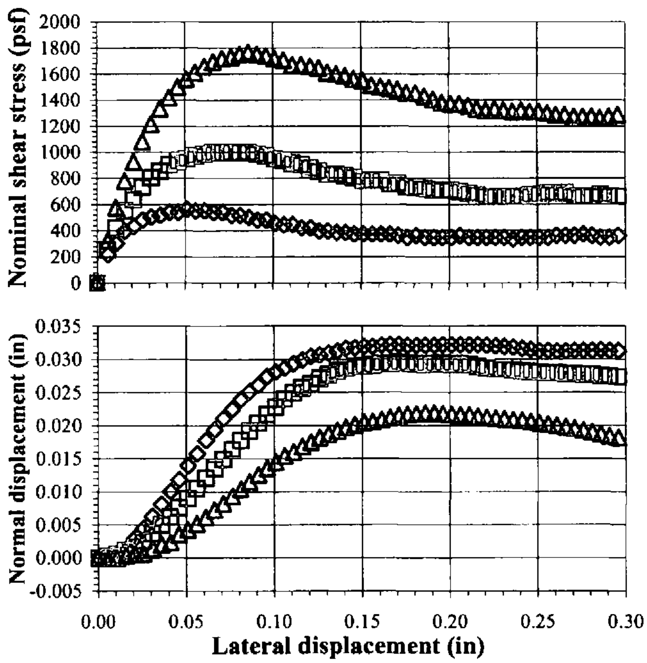
Test type: Inundated
Lateral displacement (in.): 0.3
Shear rate (in./min): 0.0172
Specific gravity, Gs: 2.65 Assumed

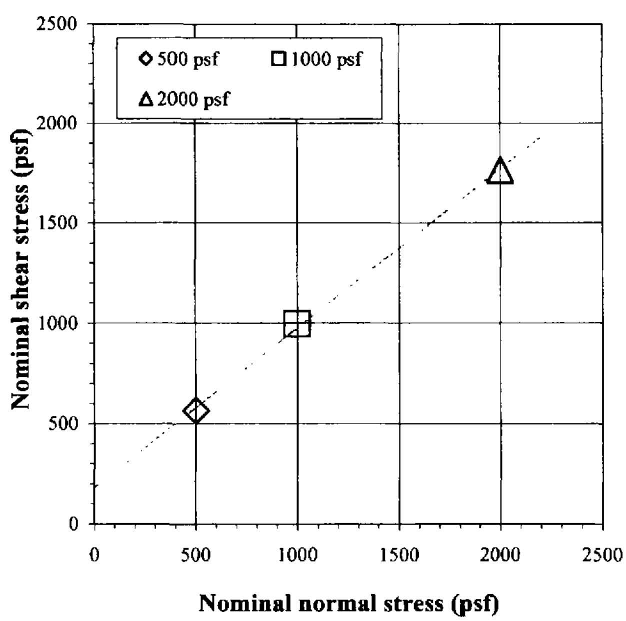
	Sample 1		Sample 2		Sample 3	
Nominal normal stress (psf)	500		1000		2000	
Peak shear stress (psf)	564		996		1764	
Lateral displacement at peak (in)	0.051		0.066		0.086	
	Initial	Pre-shear	Initial	Pre-shear	Initial	Pre-shear
Sample height (in)	1.0000	0.9950	1.0000	0.9903	1.0000	0.9859
Sample diameter (in)	2.416	2.416	2.416	2.416	2.416	2.416
Wt. rings + wet soil (g)	204.83	207.09	205.04	206.94	207.61	209.18
Wt. rings (g)	42.41	42.41	42.62	42.62	45.19	45.19
Wet soil + tare (g)	324.30	183.95	324.30	182.97	324.30	183.80
Dry soil + tare (g)	302.55	163.49	302.55	163.18	302.55	164.02
Tare (g)	127.94	21.06	127.94	20.67	127.94	21.78
Water content (%)	12.5	14.0	12.5	13.8	12.5	13.5
Dry unit weight (pcf)	120.0	120.6	120.0	121.1	120.0	121.7
Void ratio, e, for assumed Gs	0.38	0.37	0.38	0.37	0.38	0.36
Saturation (%)*	87.2	100.0	87.2	100.0	87.2	100.0

ϕ' (deg)	38
c' (psf)	180

Average of 3 samples	Initial	Pre-shear
Water content (%)	12.5	13.8
Dry unit weight (pcf)	120.0	121.1

*Pre-shear saturation set to 100% for phase calculations





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Nominal normal stress = 500 psf			Nominal normal stress = 1000 psf			Nominal normal stress = 2000 psf		
Lateral Displacement (in.)	Nominal Shear Stress (psf)	Normal Displacement (in.)	Lateral Displacement (in.)	Nominal Shear Stress (psf)	Normal Displacement (in.)	Lateral Displacement (in.)	Nominal Shear Stress (psf)	Normal Displacement (in.)
0	0	0.0000	0	0	0.0000	0	0	0.0000
0.006	216	0.0001	0.006	252	0.0003	0.006	324	-0.0001
0.011	300	0.0004	0.011	420	0.0006	0.011	576	-0.0001
0.016	396	0.0013	0.016	552	0.0011	0.016	780	0.0003
0.021	432	0.0030	0.021	636	0.0016	0.021	924	0.0005
0.026	480	0.0045	0.026	732	0.0026	0.026	1080	0.0006
0.031	504	0.0063	0.031	804	0.0037	0.031	1212	0.0014
0.036	516	0.0081	0.036	852	0.0050	0.036	1332	0.0020
0.041	540	0.0101	0.041	900	0.0062	0.041	1416	0.0023
0.046	540	0.0118	0.046	924	0.0076	0.046	1500	0.0035
0.051	564	0.0140	0.051	948	0.0090	0.051	1560	0.0043
0.056	552	0.0158	0.056	972	0.0105	0.056	1608	0.0052
0.061	552	0.0178	0.061	984	0.0121	0.061	1656	0.0061
0.066	540	0.0194	0.066	996	0.0135	0.066	1692	0.0072
0.071	540	0.0211	0.071	996	0.0149	0.071	1716	0.0082
0.076	516	0.0225	0.076	996	0.0164	0.076	1728	0.0093
0.081	516	0.0240	0.081	996	0.0178	0.081	1752	0.0104
0.086	504	0.0251	0.086	996	0.0192	0.086	1764	0.0115
0.091	480	0.0261	0.091	984	0.0204	0.091	1752	0.0126
0.096	480	0.0274	0.096	972	0.0217	0.096	1740	0.0136
0.101	456	0.0281	0.101	948	0.0228	0.101	1716	0.0145
0.106	444	0.0287	0.106	936	0.0240	0.106	1704	0.0154
0.111	444	0.0293	0.111	912	0.0249	0.111	1668	0.0160
0.116	420	0.0299	0.116	900	0.0257	0.116	1668	0.0168
0.121	420	0.0304	0.121	876	0.0263	0.121	1656	0.0175
0.126	396	0.0306	0.126	852	0.0271	0.126	1644	0.0182
0.131	396	0.0309	0.131	828	0.0277	0.131	1608	0.0187
0.136	384	0.0312	0.136	828	0.0282	0.136	1596	0.0192
0.141	384	0.0316	0.141	816	0.0286	0.141	1584	0.0197
0.146	372	0.0317	0.146	804	0.0289	0.146	1560	0.0201
0.151	372	0.0319	0.151	780	0.0290	0.151	1548	0.0205
0.156	372	0.0319	0.156	780	0.0291	0.156	1512	0.0206
0.161	372	0.0321	0.161	780	0.0293	0.161	1500	0.0209
0.166	372	0.0322	0.166	756	0.0293	0.166	1488	0.0212
0.171	360	0.0322	0.171	756	0.0295	0.171	1476	0.0215
0.176	348	0.0321	0.176	732	0.0294	0.176	1452	0.0217
0.181	360	0.0321	0.181	732	0.0293	0.181	1452	0.0218
0.186	348	0.0321	0.186	720	0.0292	0.186	1428	0.0219
0.191	348	0.0321	0.191	708	0.0293	0.191	1404	0.0219
0.196	348	0.0322	0.196	708	0.0294	0.196	1380	0.0218
0.201	348	0.0322	0.201	708	0.0292	0.201	1368	0.0217
0.206	360	0.0322	0.206	696	0.0293	0.206	1368	0.0216
0.211	348	0.0322	0.211	684	0.0292	0.211	1356	0.0216
0.216	348	0.0322	0.216	672	0.0289	0.216	1332	0.0214
0.221	348	0.0321	0.221	660	0.0287	0.221	1320	0.0212
0.226	348	0.0320	0.226	660	0.0286	0.226	1332	0.0211
0.231	348	0.0319	0.231	660	0.0285	0.231	1320	0.0210
0.236	336	0.0318	0.236	660	0.0284	0.236	1308	0.0209
0.241	348	0.0316	0.241	660	0.0282	0.241	1320	0.0208
0.246	348	0.0315	0.246	672	0.0281	0.246	1308	0.0206
0.251	348	0.0313	0.251	672	0.0280	0.251	1308	0.0204
0.256	348	0.0313	0.256	684	0.0279	0.256	1296	0.0202
0.261	360	0.0312	0.261	672	0.0279	0.261	1284	0.0200
0.266	360	0.0312	0.266	684	0.0278	0.266	1284	0.0198
0.271	360	0.0313	0.271	660	0.0278	0.271	1272	0.0196
0.276	372	0.0313	0.276	660	0.0277	0.276	1272	0.0193
0.281	360	0.0313	0.281	660	0.0277	0.281	1272	0.0190
0.286	348	0.0314	0.286	672	0.0275	0.286	1260	0.0187
0.291	348	0.0313	0.291	660	0.0274	0.291	1272	0.0184
0.296	360	0.0313	0.296	660	0.0273	0.296	1284	0.0182
0.301	348	0.0313	0.301	672	0.0270	0.301	1284	0.0180

Direct Shear Test for Soils Under Drained Conditions

(ASTM D3080)

IGES

Project: CS Mining Existing Facility Expansion
No: 01640-001 (II)
Location: Milford, UT
Date: 3/25/2013
By: JDF

Boring No.: TP-9
Sample:
Depth: 3-4'
Sample Description: Brown silty sand
Sample type: Laboratory compacted
Dry unit weight 117.8 pcf
at 12.4 (%) w
Compaction specifications: 95% of ASTM D698B

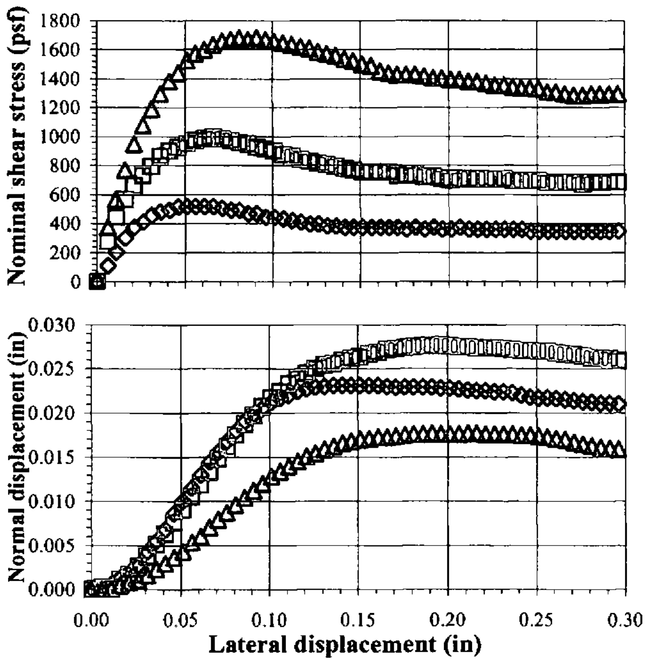
Test type: Inundated
Lateral displacement (in.): 0.3
Shear rate (in./min): 0.0172
Specific gravity, Gs: 2.65 Assumed

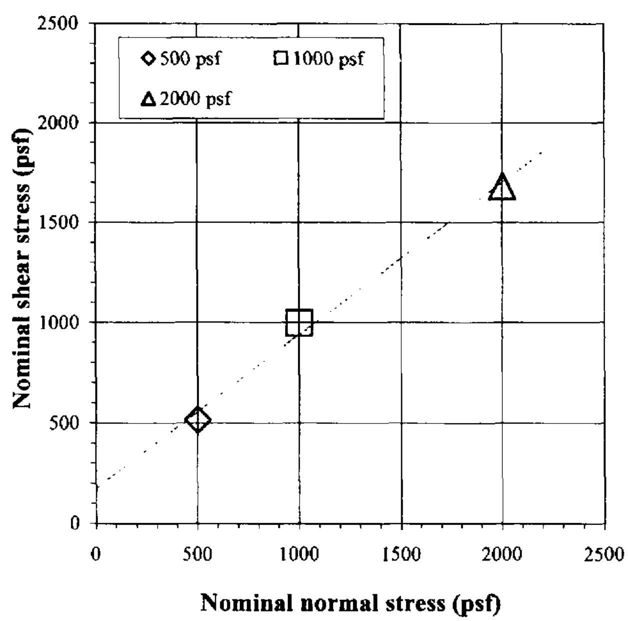
	Sample 1		Sample 2		Sample 3	
Nominal normal stress (psf)	500		1000		2000	
Peak shear stress (psf)	516		996		1680	
Lateral displacement at peak (in)	0.046		0.066		0.081	
	Initial	Pre-shear	Initial	Pre-shear	Initial	Pre-shear
Sample height (in)	1.0000	0.9937	1.0000	0.9894	1.0000	0.9838
Sample diameter (in)	2.416	2.416	2.416	2.416	2.416	2.416
Wt. rings + wet soil (g)	205.96	209.47	202.61	205.80	203.34	206.11
Wt. rings (g)	46.48	46.48	43.13	43.13	43.86	43.86
Wet soil + tare (g)	263.21	181.72	263.21	181.24	263.21	182.40
Dry soil + tare (g)	247.90	161.22	247.90	161.33	247.90	162.60
Tare (g)	124.46	21.06	124.46	21.30	124.46	22.49
Water content (%)	12.4	14.9	12.4	14.7	12.4	14.4
Dry unit weight (pcf)	117.9	118.6	117.9	119.1	117.9	119.8
Void ratio, e, for assumed Gs	0.40	0.39	0.40	0.39	0.40	0.38
Saturation (%)*	81.5	100.0	81.5	100.0	81.5	100.0

φ' (deg)	37
c' (psf)	174

Average of 3 samples	Initial	Pre-shear
Water content (%)	12.4	14.6
Dry unit weight (pcf)	117.9	119.2

*Pre-shear saturation set to 100% for phase calculations





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Nominal normal stress = 500 psf			Nominal normal stress = 1000 psf			Nominal normal stress = 2000 psf		
Lateral Displacement (in.)	Nominal Shear Stress (psf)	Normal Displacement (in.)	Lateral Displacement (in.)	Nominal Shear Stress (psf)	Normal Displacement (in.)	Lateral Displacement (in.)	Nominal Shear Stress (psf)	Normal Displacement (in.)
0	0	0.0000	0	0	0.0000	0	12	0.0000
0.006	108	0.0002	0.006	276	0.0002	0.006	372	0.0000
0.011	204	0.0006	0.011	444	0.0002	0.011	564	0.0000
0.016	300	0.0013	0.016	564	0.0011	0.016	768	0.0005
0.021	372	0.0019	0.021	660	0.0017	0.021	948	0.0008
0.026	408	0.0027	0.026	732	0.0026	0.026	1080	0.0010
0.031	456	0.0043	0.031	792	0.0037	0.031	1188	0.0016
0.036	480	0.0055	0.036	864	0.0051	0.036	1296	0.0023
0.041	492	0.0068	0.041	900	0.0063	0.041	1380	0.0029
0.046	516	0.0086	0.046	924	0.0076	0.046	1440	0.0036
0.051	516	0.0100	0.051	948	0.0090	0.051	1524	0.0043
0.056	516	0.0115	0.056	972	0.0105	0.056	1572	0.0053
0.061	516	0.0130	0.061	984	0.0118	0.061	1596	0.0060
0.066	516	0.0144	0.066	996	0.0133	0.066	1632	0.0070
0.071	504	0.0156	0.071	984	0.0148	0.071	1656	0.0079
0.076	492	0.0168	0.076	972	0.0161	0.076	1668	0.0087
0.081	492	0.0179	0.081	960	0.0175	0.081	1680	0.0096
0.086	468	0.0190	0.086	948	0.0187	0.086	1668	0.0104
0.091	468	0.0198	0.091	924	0.0197	0.091	1680	0.0112
0.096	444	0.0205	0.096	912	0.0207	0.096	1668	0.0120
0.101	444	0.0212	0.101	900	0.0217	0.101	1656	0.0128
0.106	432	0.0217	0.106	876	0.0224	0.106	1644	0.0134
0.111	420	0.0220	0.111	864	0.0233	0.111	1632	0.0140
0.116	408	0.0224	0.116	840	0.0239	0.116	1620	0.0145
0.121	396	0.0227	0.121	828	0.0245	0.121	1608	0.0151
0.126	396	0.0229	0.126	816	0.0250	0.126	1584	0.0154
0.131	384	0.0230	0.131	804	0.0254	0.131	1572	0.0159
0.136	384	0.0231	0.136	792	0.0256	0.136	1560	0.0162
0.141	372	0.0231	0.141	780	0.0260	0.141	1536	0.0166
0.146	372	0.0231	0.146	768	0.0262	0.146	1524	0.0168
0.151	372	0.0231	0.151	756	0.0264	0.151	1500	0.0170
0.156	372	0.0231	0.156	756	0.0267	0.156	1488	0.0171
0.161	372	0.0231	0.161	756	0.0269	0.161	1452	0.0173
0.166	372	0.0230	0.166	756	0.0272	0.166	1440	0.0173
0.171	372	0.0229	0.171	732	0.0273	0.171	1428	0.0174
0.176	360	0.0229	0.176	732	0.0274	0.176	1428	0.0175
0.181	372	0.0229	0.181	732	0.0275	0.181	1428	0.0176
0.186	360	0.0229	0.186	720	0.0276	0.186	1416	0.0176
0.191	372	0.0229	0.191	720	0.0276	0.191	1404	0.0177
0.196	360	0.0228	0.196	708	0.0277	0.196	1404	0.0176
0.201	360	0.0228	0.201	696	0.0276	0.201	1392	0.0176
0.206	372	0.0227	0.206	708	0.0275	0.206	1392	0.0176
0.211	360	0.0226	0.211	708	0.0275	0.211	1380	0.0177
0.216	360	0.0225	0.216	708	0.0274	0.216	1380	0.0177
0.221	360	0.0225	0.221	708	0.0274	0.221	1368	0.0176
0.226	360	0.0224	0.226	708	0.0274	0.226	1356	0.0176
0.231	360	0.0224	0.231	708	0.0273	0.231	1356	0.0176
0.236	360	0.0223	0.236	696	0.0272	0.236	1344	0.0176
0.241	360	0.0220	0.241	696	0.0271	0.241	1332	0.0175
0.246	348	0.0218	0.246	696	0.0271	0.246	1332	0.0175
0.251	348	0.0217	0.251	696	0.0270	0.251	1332	0.0174
0.256	348	0.0217	0.256	684	0.0270	0.256	1308	0.0173
0.261	348	0.0216	0.261	684	0.0268	0.261	1308	0.0171
0.266	348	0.0215	0.266	684	0.0267	0.266	1296	0.0170
0.271	348	0.0214	0.271	684	0.0266	0.271	1284	0.0167
0.276	348	0.0213	0.276	672	0.0265	0.276	1284	0.0165
0.281	348	0.0212	0.281	684	0.0263	0.281	1296	0.0163
0.286	348	0.0211	0.286	684	0.0262	0.286	1296	0.0161
0.291	348	0.0211	0.291	684	0.0261	0.291	1296	0.0160
0.296	348	0.0210	0.296	684	0.0259	0.296	1296	0.0159
0.301	348	0.0210	0.301	684	0.0257	0.301	1284	0.0157

Direct Shear Test for Soils Under Drained Conditions

(ASTM D3080)

Project: **CS Mining Existing Facility Expansion**
No: **01640-001 (II)**
Location: Milford, UT
Date: 3/14/2013
By: JDF

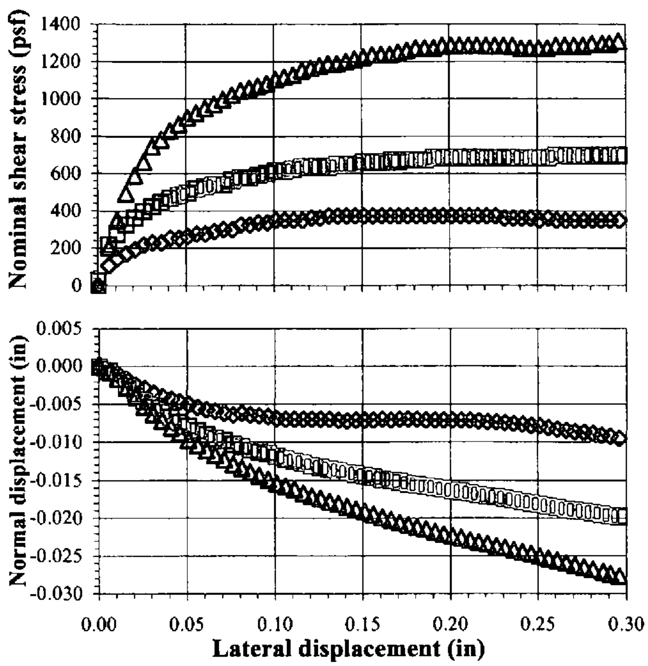
Boring No.: **Tailings Beach**
Sample: **7**
Depth: **Surface**
Sample Description: Grey silty sand
Sample type: Undisturbed-trimmed from thin-wall

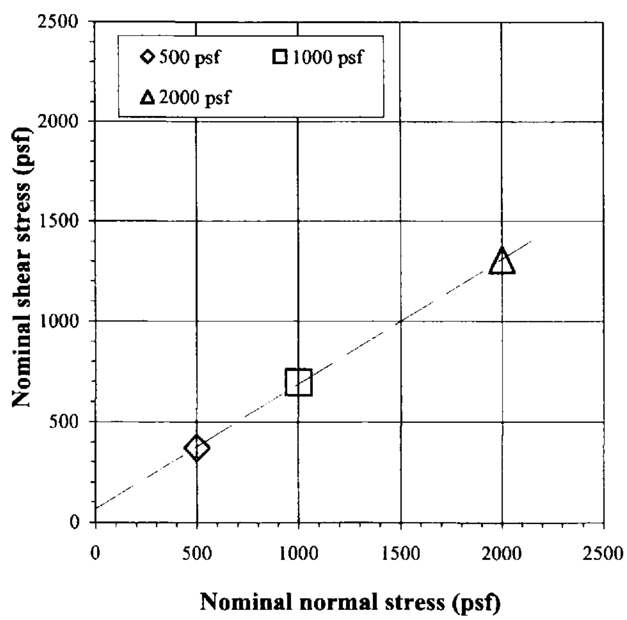
Test type: Inundated
Lateral displacement (in.): 0.3
Shear rate (in./min): 0.0200
Specific gravity, Gs: 3.13 Measured

	Sample 1		Sample 2		Sample 3	
Nominal normal stress (psf)	500		1000		2000	
Peak shear stress (psf)	372		696		1308	
Lateral displacement at peak (in)	0.131		0.261		0.296	
	Initial	Pre-shear	Initial	Pre-shear	Initial	Pre-shear
Sample height (in)	1.0000	0.9855	1.0000	0.9557	1.0000	0.9367
Sample diameter (in)	2.416	2.416	2.416	2.416	2.416	2.416
Wt. rings + wet soil (g)	195.82	197.17	198.90	198.41	198.12	194.84
Wt. rings (g)	42.34	42.34	46.26	46.26	42.62	42.62
Wet soil + tare (g)	226.12	167.10	226.12	157.01	226.12	163.74
Dry soil + tare (g)	203.63	134.53	203.63	130.60	203.63	138.64
Tare (g)	127.02	21.05	127.02	20.68	127.02	21.76
Water content (%)	29.4	30.5	29.4	28.9	29.4	26.6
Dry unit weight (pcf)	98.6	100.0	98.1	102.6	99.9	106.6
Void ratio, e, for assumed Gs	0.98	0.96	1.00	0.91	0.96	0.83
Saturation (%)*	93.5	100.0	92.4	100.0	96.0	100.0

ϕ' (deg)	32	Average of 3 samples	Initial	Pre-shear
c' (psf)	66	Water content (%)	29.4	28.7
		Dry unit weight (pcf)	98.8	103.1

*Pre-shear saturation set to 100% for phase calculations





Entered by:__________
Reviewed:__________

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Nominal normal stress = 500 psf			Nominal normal stress = 1000 psf			Nominal normal stress = 2000 psf		
Lateral Displacement (in.)	Nominal Shear Stress (psf)	Normal Displacement (in.)	Lateral Displacement (in.)	Nominal Shear Stress (psf)	Normal Displacement (in.)	Lateral Displacement (in.)	Nominal Shear Stress (psf)	Normal Displacement (in.)
0	0	0.0002	0	24	-0.0001	0	0	0.0001
0.006	108	-0.0005	0.006	216	-0.0006	0.006	204	-0.0007
0.011	144	-0.0011	0.011	276	-0.0017	0.011	348	-0.0016
0.016	168	-0.0018	0.016	324	-0.0027	0.016	492	-0.0028
0.021	192	-0.0025	0.021	360	-0.0037	0.021	588	-0.0040
0.026	216	-0.0029	0.026	396	-0.0046	0.026	660	-0.0053
0.031	228	-0.0035	0.031	420	-0.0053	0.031	744	-0.0063
0.036	228	-0.0040	0.036	444	-0.0060	0.036	780	-0.0072
0.041	252	-0.0043	0.041	468	-0.0067	0.041	828	-0.0081
0.046	252	-0.0047	0.046	480	-0.0074	0.046	864	-0.0088
0.051	264	-0.0050	0.051	492	-0.0079	0.051	900	-0.0097
0.056	276	-0.0054	0.056	516	-0.0085	0.056	924	-0.0104
0.061	276	-0.0057	0.061	528	-0.0090	0.061	948	-0.0111
0.066	288	-0.0059	0.066	540	-0.0095	0.066	972	-0.0117
0.071	300	-0.0062	0.071	540	-0.0098	0.071	996	-0.0123
0.076	300	-0.0064	0.076	564	-0.0103	0.076	1020	-0.0129
0.081	324	-0.0062	0.081	576	-0.0106	0.081	1044	-0.0134
0.086	324	-0.0064	0.086	576	-0.0110	0.086	1056	-0.0139
0.091	336	-0.0065	0.091	588	-0.0113	0.091	1068	-0.0144
0.096	336	-0.0066	0.096	600	-0.0115	0.096	1080	-0.0149
0.101	348	-0.0069	0.101	612	-0.0119	0.101	1104	-0.0154
0.106	348	-0.0070	0.106	612	-0.0122	0.106	1116	-0.0158
0.111	348	-0.0070	0.111	624	-0.0125	0.111	1128	-0.0162
0.116	348	-0.0070	0.116	636	-0.0127	0.116	1152	-0.0167
0.121	360	-0.0070	0.121	636	-0.0131	0.121	1164	-0.0171
0.126	360	-0.0070	0.126	636	-0.0133	0.126	1176	-0.0174
0.131	372	-0.0070	0.131	636	-0.0135	0.131	1188	-0.0178
0.136	372	-0.0071	0.136	648	-0.0137	0.136	1188	-0.0181
0.141	372	-0.0072	0.141	648	-0.0140	0.141	1200	-0.0185
0.146	372	-0.0071	0.146	648	-0.0142	0.146	1212	-0.0188
0.151	372	-0.0071	0.151	660	-0.0144	0.151	1224	-0.0191
0.156	372	-0.0071	0.156	660	-0.0146	0.156	1236	-0.0195
0.161	372	-0.0070	0.161	660	-0.0149	0.161	1236	-0.0199
0.166	372	-0.0071	0.167	672	-0.0150	0.166	1236	-0.0202
0.171	372	-0.0070	0.171	660	-0.0152	0.171	1248	-0.0206
0.176	372	-0.0070	0.176	672	-0.0155	0.176	1260	-0.0209
0.181	372	-0.0070	0.181	672	-0.0156	0.181	1272	-0.0212
0.186	372	-0.0071	0.186	672	-0.0158	0.186	1272	-0.0215
0.191	372	-0.0071	0.191	684	-0.0160	0.191	1272	-0.0218
0.196	372	-0.0071	0.196	684	-0.0162	0.196	1284	-0.0221
0.201	372	-0.0071	0.201	684	-0.0164	0.201	1284	-0.0224
0.206	372	-0.0071	0.206	684	-0.0165	0.206	1284	-0.0226
0.211	372	-0.0071	0.211	684	-0.0167	0.211	1284	-0.0229
0.216	372	-0.0072	0.216	684	-0.0169	0.216	1284	-0.0232
0.221	372	-0.0073	0.221	684	-0.0171	0.221	1284	-0.0234
0.226	372	-0.0073	0.226	684	-0.0172	0.226	1284	-0.0237
0.231	360	-0.0074	0.231	684	-0.0174	0.231	1284	-0.0239
0.236	360	-0.0075	0.236	684	-0.0176	0.236	1284	-0.0242
0.241	360	-0.0076	0.241	684	-0.0178	0.241	1272	-0.0245
0.246	360	-0.0078	0.246	684	-0.0180	0.246	1272	-0.0247
0.251	348	-0.0079	0.251	684	-0.0182	0.251	1272	-0.0250
0.256	360	-0.0081	0.256	684	-0.0184	0.256	1272	-0.0253
0.261	348	-0.0083	0.261	696	-0.0186	0.261	1284	-0.0256
0.266	348	-0.0084	0.266	696	-0.0188	0.266	1284	-0.0259
0.271	348	-0.0086	0.271	696	-0.0190	0.271	1284	-0.0262
0.276	348	-0.0087	0.276	696	-0.0191	0.276	1284	-0.0265
0.281	348	-0.0089	0.281	696	-0.0193	0.281	1296	-0.0268
0.286	348	-0.0091	0.286	696	-0.0195	0.287	1296	-0.0271
0.291	348	-0.0092	0.291	696	-0.0197	0.291	1296	-0.0274
0.296	348	-0.0095	0.296	696	-0.0198	0.296	1308	-0.0277
0.301	348	-0.0096	0.301	684	-0.0200	0.301	1308	-0.0279

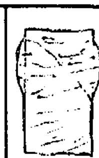
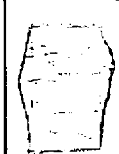
Consolidated Undrained Triaxial Compression Test for Cohesive Soils

(ASTM D4767)

IGES

Project: CS Mining Existing Facility
No: 01640-001(II)
Location: Milford, UT
Date: 3/25/2013
By: MP

Boring No.: TP-3
Sample:
Depth: 1-3'
Sample Description: Brown silty sand
Engineering Classification: Not requested
Sample type: Laboratory compacted

	Test Number:	S1	S2	S3
Initial	Height, H (in)	5.970	5.989	5.997
	Diameter, D (in)	2.422	2.420	2.420
	Water content, w (%)	12.1	12.1	12.1
	Dry unit weight, γ_d (pcf)	121.4	121.2	121.1
	Saturation (%)	88.4	88.0	87.6
	Void ratio, e	0.36	0.36	0.37
	Mounting	Wet	Wet	Wet
Before shear	Water content, w (%)	14.7	14.6	14.6
	Dry unit weight, γ_d (pcf)	119.1	119.2	119.3
	Saturation[a] (%)	100.0	100.0	100.0
	Void ratio, e	0.39	0.39	0.39
	Area, A_{eoc} (in^2)	4.69	4.72	4.65
	Area method	A	A	A
	B	0.95	0.95	0.95
	t_{50} (min)	0.15	0.15	0.11
	Back pressure (psf)	6407	9791	6912
	Strain rate (%/min)	0.06	0.06	0.06
	Time to failure (min)	333.3	78.3	66.7
	Strain at failure, ε_f (%)	20.00	4.70	4.00
	Filter paper correction	No	No	No
	Membrane correction	Yes	Yes	Yes
	Assumed specific gravity 2.65			

[a] Saturation set to 100% for phase calculations

Summary of strength parameters at peak deviator stress		
Total stress	c (psf)	1076
	ϕ (deg)	19.5
Effective stress	c' (psf)	77
	ϕ' (deg)	37.1

Comments:
Specimens were compacted to 95% of the MDUW at OWC +2%. The maximum dry unit weight and optimum water content from the Proctor test was 127.5 pcf and 10.3% respectively.

Tested by:__________

Reviewed:__________

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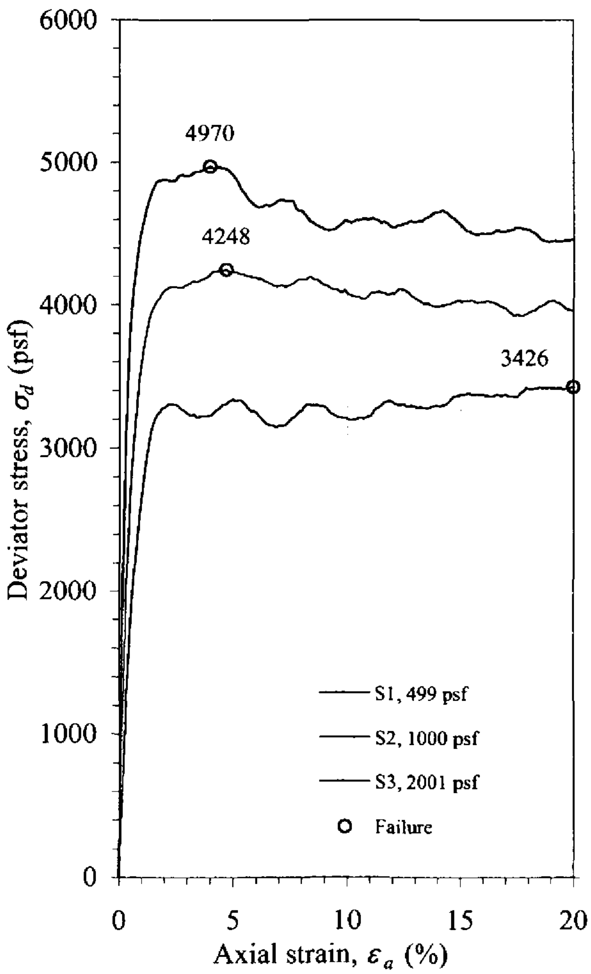
Consolidated Undrained Triaxial Compression Test for Cohesive Soils

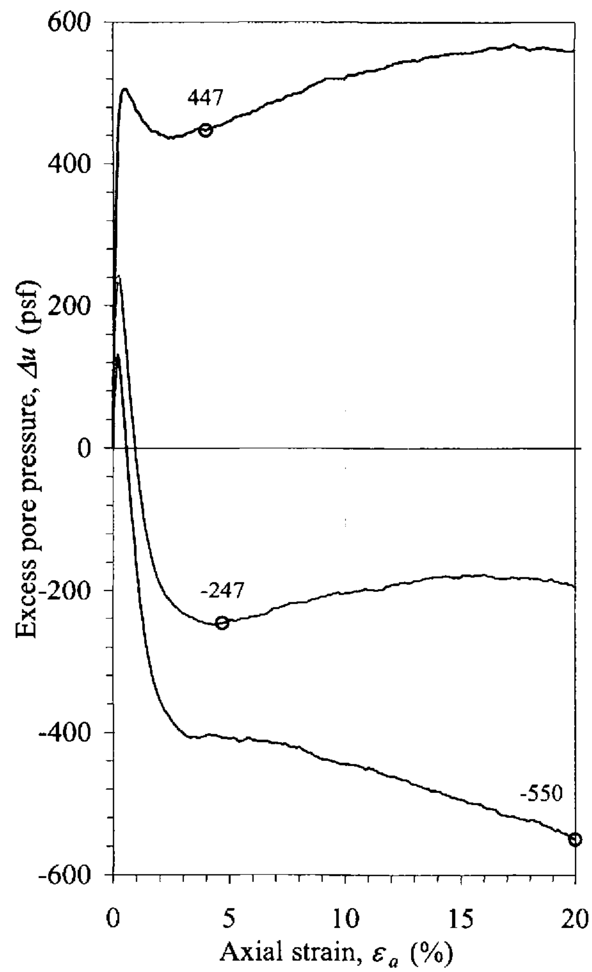
IGES

(*ASTM D4767*)

Project: CS Mining Existing Facility | Boring No.: TP-3
No: 01640-001(II) | Sample:
Location: Milford, UT | Depth: 1-3'

	Test Number:	S1	S2	S3
Total stress	σ_3 (psf)	499	1000	2001
	σ_1-σ_3 (psf)	3426	4248	4970
	σ_1 (psf)	3925	5248	6972
	$q = (\sigma_1 - \sigma_3)/2$ (psf)	1713	2124	2485
	$p = (\sigma_1 + \sigma_3)/2$ (psf)	2212	3124	4486
Effective stress	Δu (psf)	-550	-247	447
	σ'_3 (psf)	1049	1247	1555
	σ'_1-σ'_3 (psf)	3426	4248	4970
	σ'_1 (psf)	4475	5494	6525
	$q = (\sigma'_1 - \sigma'_3)/2$ (psf)	1713	2124	2485
	$p' = (\sigma'_1 + \sigma'_3)/2$ (psf)	2762	3371	4040
	σ'_1/σ'_3	4.26	4.41	4.20
	$A = \Delta u/(\sigma_1 - \sigma_3)$	-0.161	-0.058	0.090





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Consolidated Undrained Triaxial Compression Test for Cohesive Soils

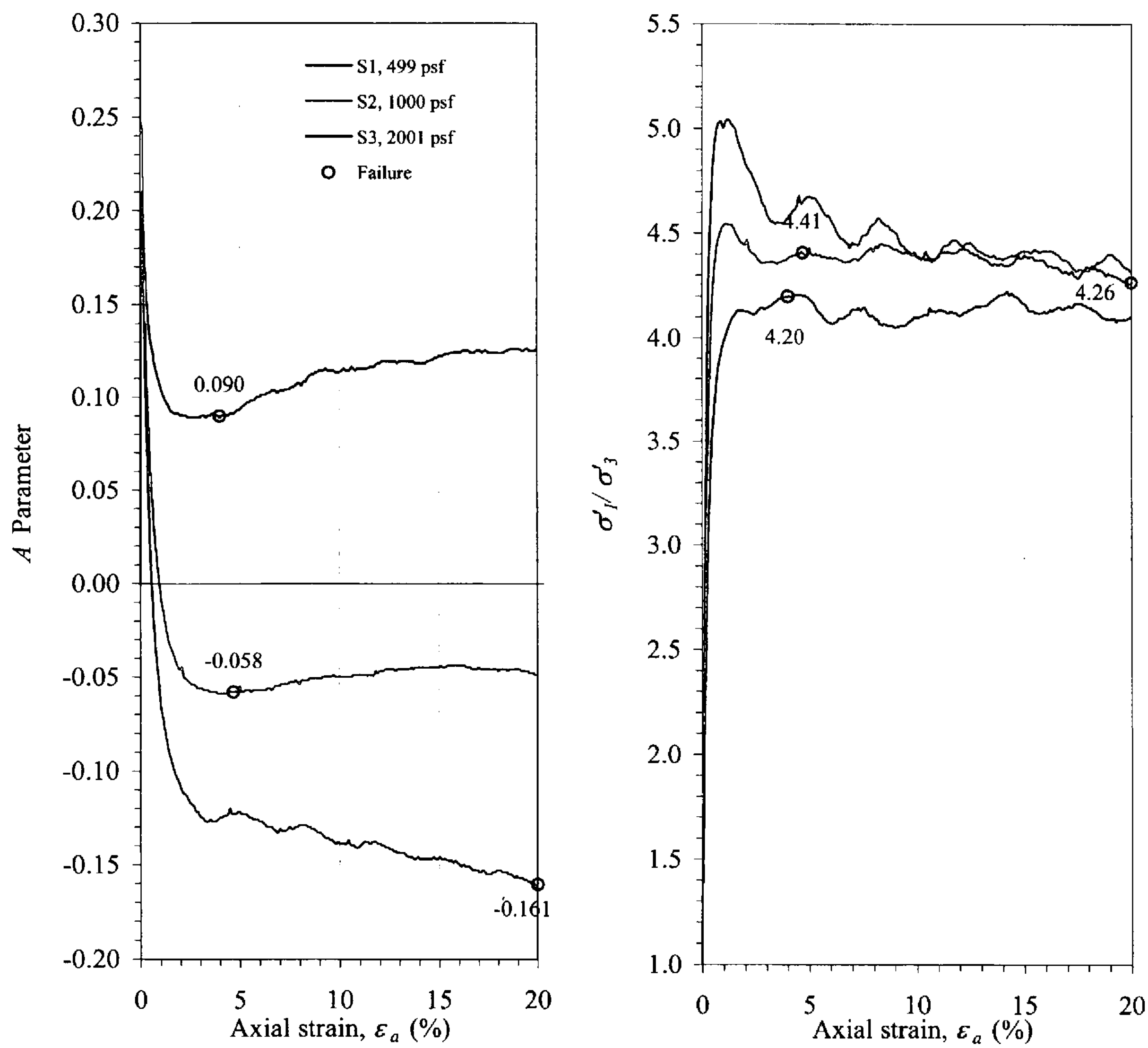
(*ASTM D4767*)

IGES

Project: CS Mining Existing Facility
No: 01640-001(II)
Location: Milford, UT

Boring No.: TP-3
Sample:
Depth: 1-3'

Summary of strength parameters at peak deviator stress		
Total stress	c (psf)	1076
	ϕ (deg)	19.5
Effective stress	c' (psf)	77
	ϕ' (deg)	37.1



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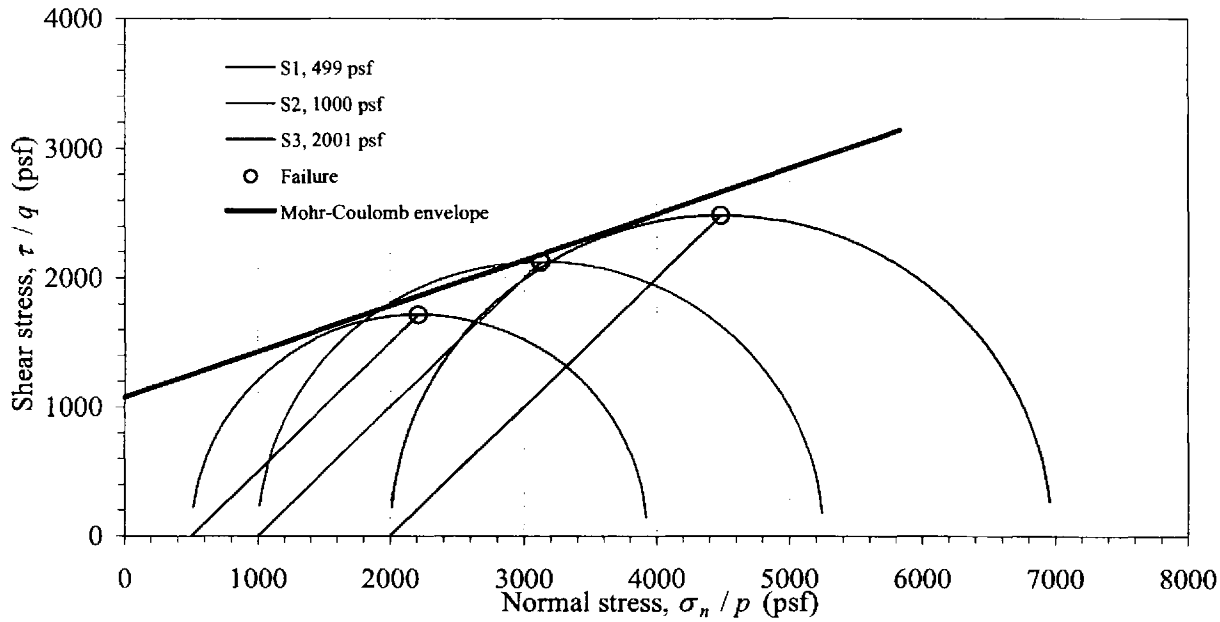
Consolidated Undrained Triaxial Compression Test for Cohesive Soils

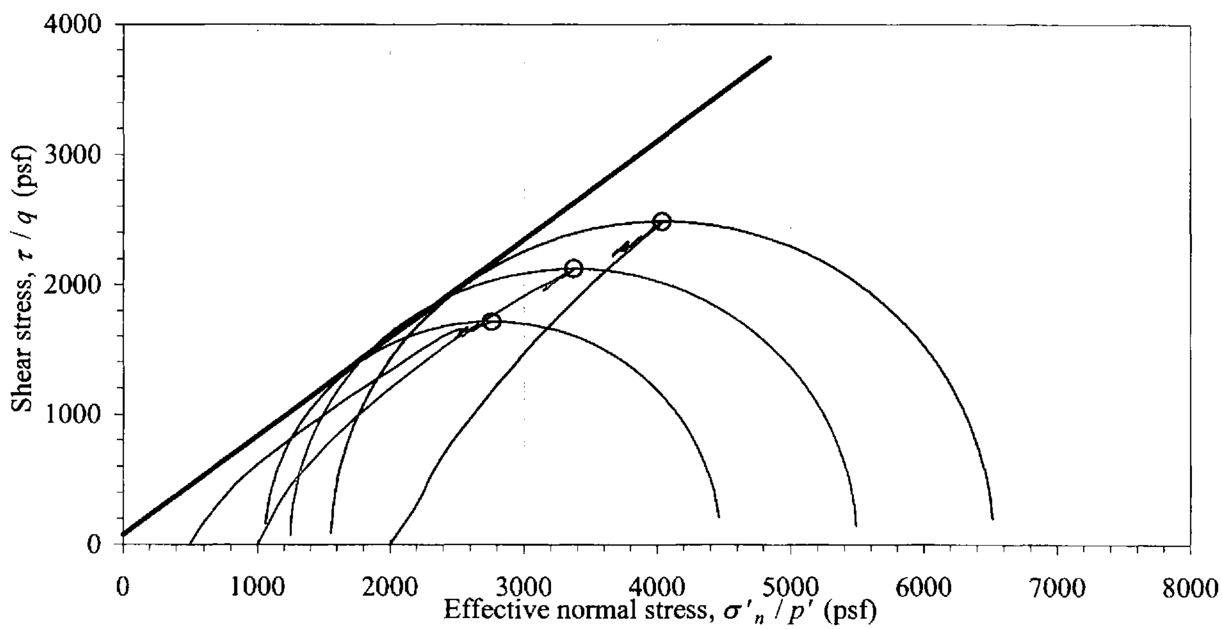
(ASTM D4767)

Project: CS Mining Existing Facility
No: 01640-001(II)
Location: Milford, UT

Boring No.: TP-3
Sample:
Depth: 1-3'

Summary of strength parameters at peak deviator stress		
Total stress	c (psf)	1076
	ϕ (deg)	19.5
Effective stress	c' (psf)	77
	ϕ' (deg)	37.1





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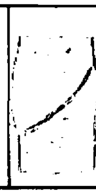
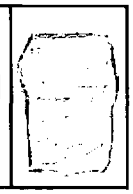
Consolidated Undrained Triaxial Compression Test for Cohesive Soils
(ASTM D4767)

IGES

Project: **CS Mining Existing Facility Expansion**
No: **01640-001 (II)**
Location: Milford, UT
Date: 3/22/2013
By: MP

Boring No.: **TP-6**
Sample:
Depth: **2-6'**
Sample Description: Brown silty sand
Engineering Classification: Not requested
Sample type: Laboratory compacted

	Test Number:	S1	S2	S3
Initial	Height, H (in)	6.000	5.994	5.976
	Diameter, D (in)	2.419	2.421	2.419
	Water content, w (%)	16.5	16.5	16.5
	Dry unit weight, γ_d (pcf)	109.5	109.4	109.7
	Saturation (%)	85.8	85.6	86.3
	Void ratio, e	0.51	0.51	0.51
	Mounting	Wet	Wet	Wet
Before shear	Water content, w (%)	20.0	19.7	20.0
	Dry unit weight, γ_d (pcf)	108.2	108.7	108.1
	Saturation[a] (%)	100.0	100.0	100.0
	Void ratio, e	0.53	0.52	0.53
	Area, A_{eoc} (in^2)	4.64	4.63	4.65
	Area method	A	A	A
	B	0.95	0.95	0.95
	t_{50} (min)	0.10	0.09	0.11
	Back pressure (psf)	7632	9790	8351
	Strain rate (%/min)	0.06	0.06	0.06
	Time to failure (min)	241.7	295.0	80.0
	Strain at failure, ε_f (%)	14.50	17.70	4.80
	Filter paper correction	No	No	No
	Membrane correction	Yes	Yes	Yes
	Assumed specific gravity 2.65			

[a] Saturation set to 100% for phase calculations

Summary of strength parameters at peak deviator stress		
Total stress	c (psf)	1034
	ϕ (deg)	27.0
Effective stress	c' (psf)	0
	ϕ' (deg)	39.0

Comments:
Specimens were compacted to 95% of the MDUW at OWC +2%. The maximum dry unit weight and optimum water content from the Proctor test was 115.5 pcf and 14.5% respectively.

Tested by:___________
Reviewed:___________

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Consolidated Undrained Triaxial Compression Test for Cohesive Soils

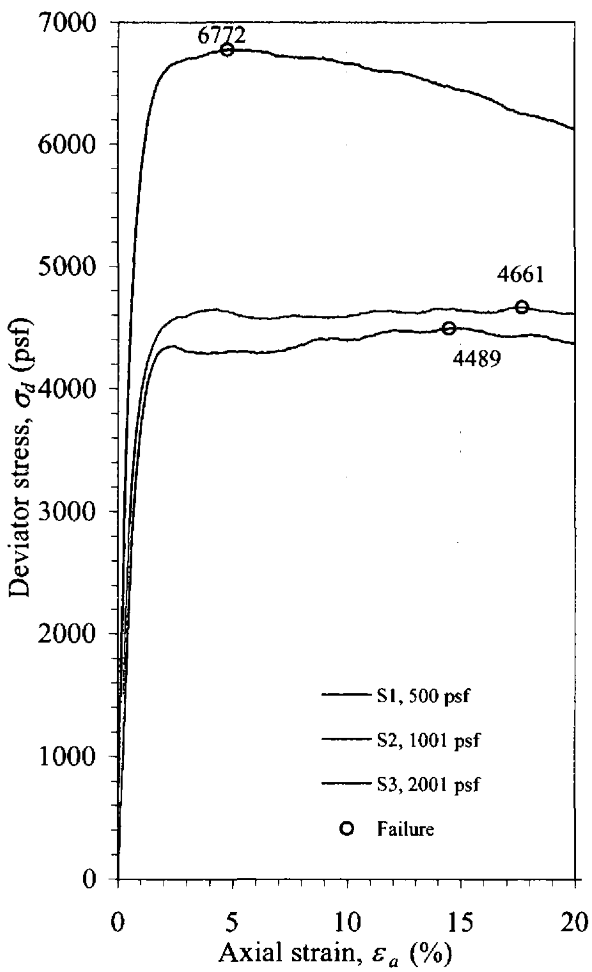
(*ASTM D4767*)

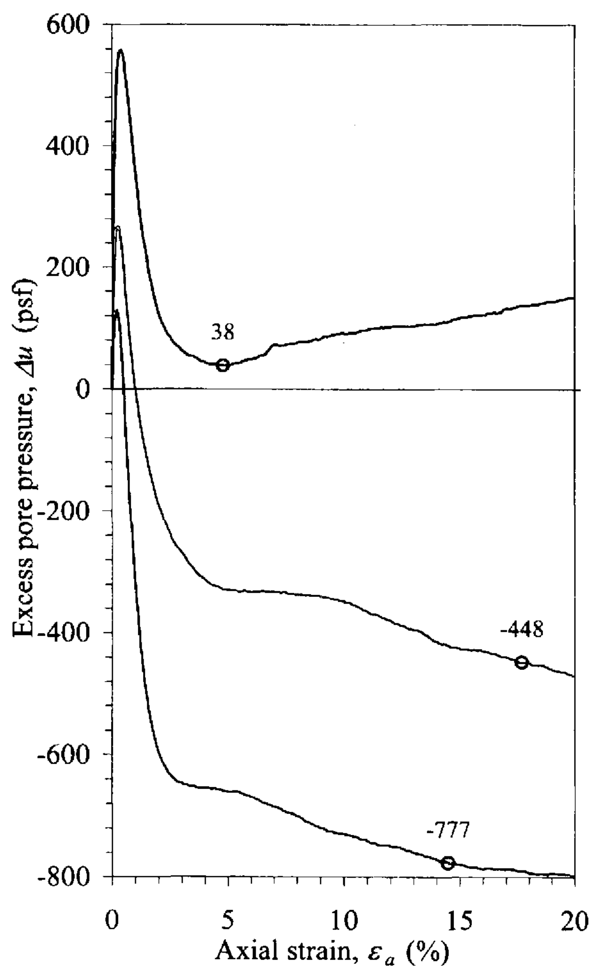
IGES

Project: CS Mining Existing Facility Expansion
No: 01640-001 (II)
Location: Milford, UT

Boring No.: TP-6
Sample:
Depth: 2-6'

	Test Number:	S1	S2	S3
Total stress	σ_3 (psf)	500	1001	2001
	σ_1-σ_3 (psf)	4489	4661	6772
	σ_1 (psf)	4989	5662	8773
	$q = (\sigma_1 - \sigma_3)/2$ (psf)	2245	2330	3386
	$p = (\sigma_1 + \sigma_3)/2$ (psf)	2744	3331	5387
Effective stress	Δu (psf)	-777	-448	38
	σ'_3 (psf)	1277	1449	1963
	σ'_1-σ'_3 (psf)	4489	4661	6772
	σ'_1 (psf)	5766	6110	8736
	$q = (\sigma'_1 - \sigma'_3)/2$ (psf)	2245	2330	3386
	$p' = (\sigma'_1 + \sigma'_3)/2$ (psf)	3521	3780	5349
	σ'_1/σ'_3	4.52	4.22	4.45
	$A = \Delta u/(\sigma_1 - \sigma_3)$	-0.173	-0.096	0.006





Z:\PROJECTS\01640_CS_mining\001_Tailings\II\[GTXCU3v2_TP-6_2-6.xls]Summary

Consolidated Undrained Triaxial Compression Test for Cohesive Soils

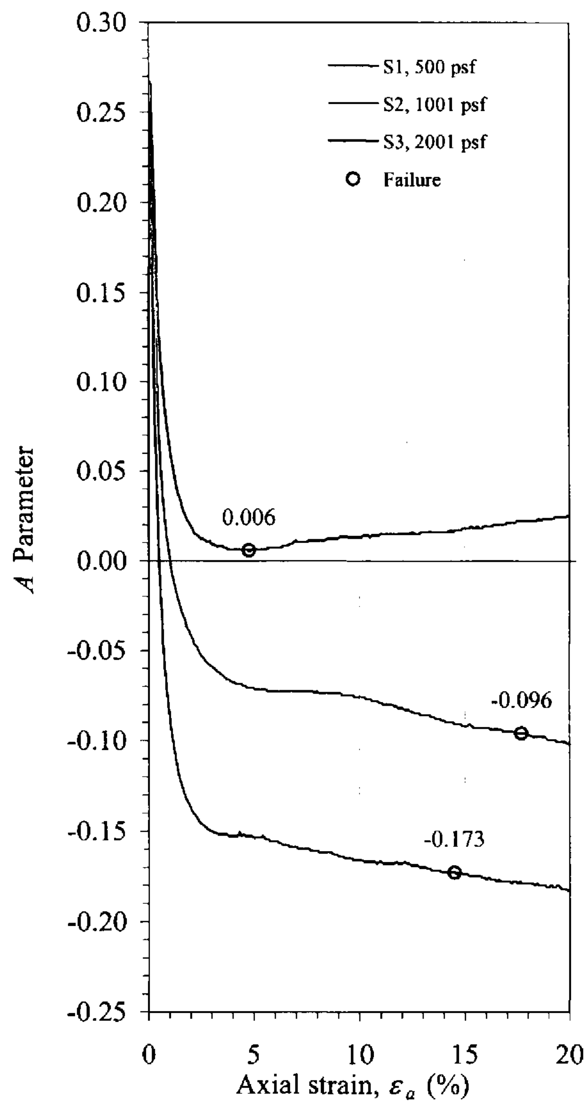
(*ASTM D4767*)

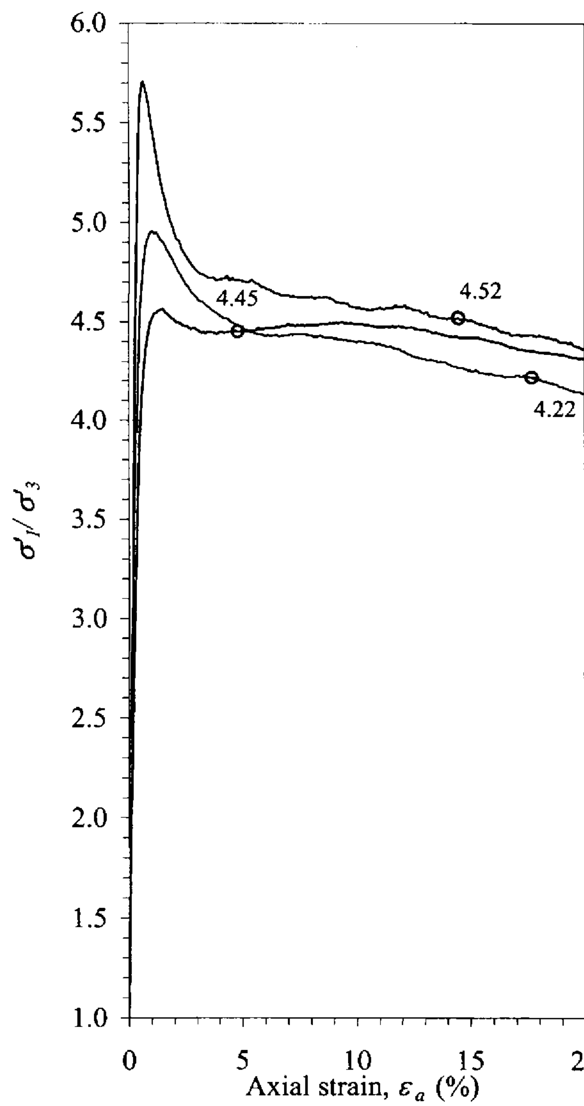
IGES

Project: CS Mining Existing Facility Expansion
No: 01640-001 (II)
Location: Milford, UT

Boring No.: TP-6
Sample:
Depth: 2-6'

Summary of strength parameters at peak deviator stress		
Total stress	c (psf)	1034
	ϕ (deg)	27.0
Effective stress	c' (psf)	0
	ϕ' (deg)	39.0





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Consolidated Undrained Triaxial Compression Test for Cohesive Soils

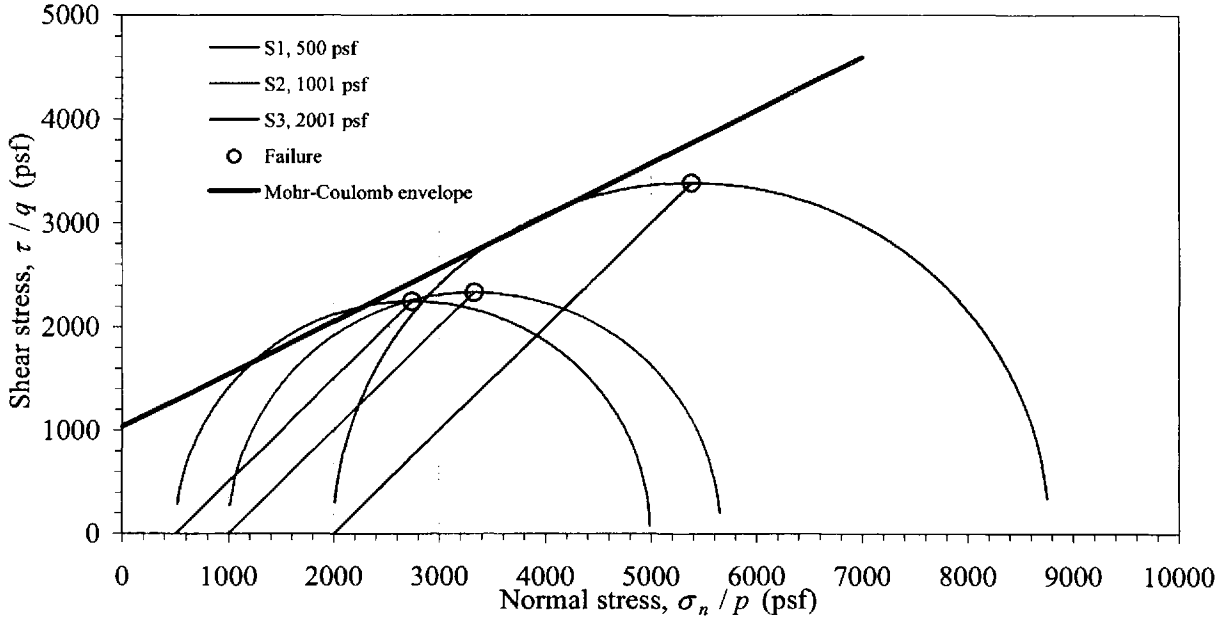
(*ASTM D4767*)

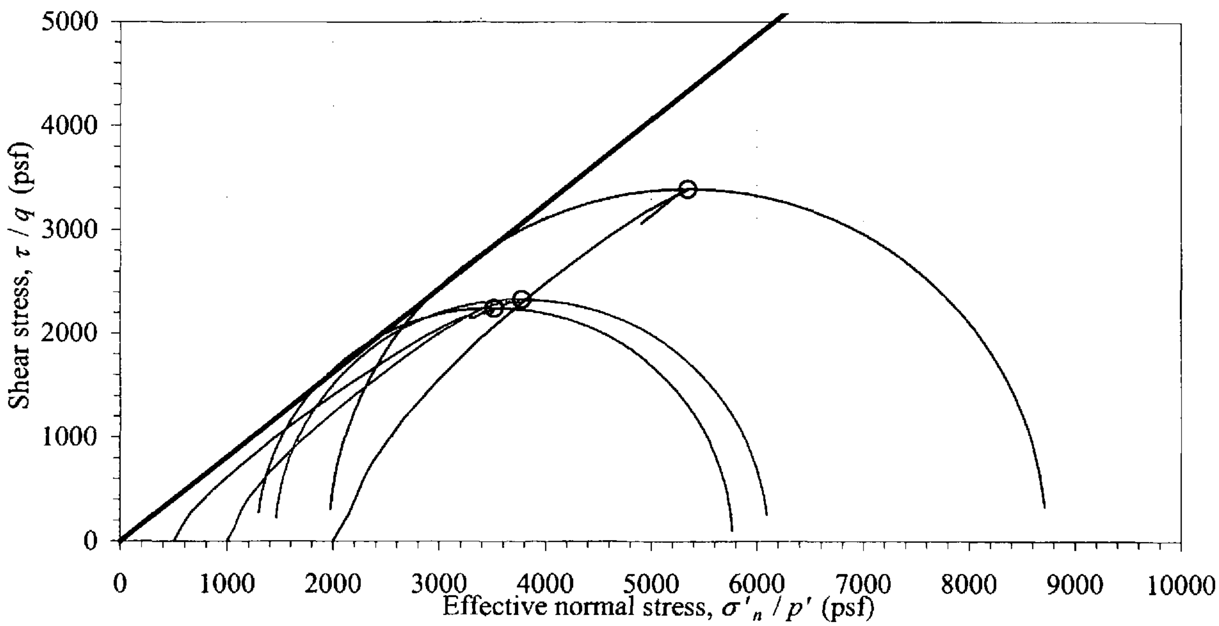
IGES

Project: CS Mining Existing Facility Expansion
No: 01640-001 (II)
Location: Milford, UT

Boring No.: TP-6
Sample:
Depth: 2-6'

Summary of strength parameters at peak deviator stress		
Total stress	c (psf)	1034
	ϕ (deg)	27.0
Effective stress	c' (psf)	0
	ϕ' (deg)	39.0





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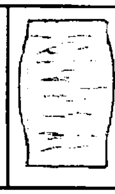
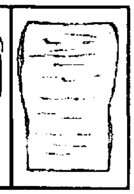
Consolidated Undrained Triaxial Compression Test for Cohesive Soils

(*ASTM D4767*)

IGES

Project: CS Mining Existing Facility Expansion
No: 01640-001 (II)
Location: Milford, UT
Date: 3/25/2013
By: MP

Boring No.: Tailings Beach
Sample: 1, 3, & 5
Depth: Surface
Sample Description: Dark grey silty sand
Engineering Classification: Not requested
Sample type: Undisturbed-trimmed from thin-wall

	Test Number:	S1	S2	S3
Initial	Height, H (in)	4.776	4.907	4.797
	Diameter, D (in)	2.325	2.342	2.325
	Water content, w (%)	33.5	33.6	34.0
	Dry unit weight, γ_d (pcf)	109.1	106.6	109.3
	Saturation (%)	132.2	126.0	135.0
	Void ratio, e	0.79	0.83	0.79
	Mounting	Wet	Wet	Wet
Before shear	Water content, w (%)	23.6	24.2	22.4
	Dry unit weight, γ_d (pcf)	112.4	111.2	115.0
	Saturation[a] (%)	100.0	100.0	100.0
	Void ratio, e	0.74	0.76	0.70
	Area, A_{eoc} (in^2)	4.37	4.40	4.28
	Area method	A	A	A
	B	0.96	0.95	0.95
	t_{50} (min)	0.09	0.10	0.10
	Back pressure (psf)	7032	9791	5471
	Strain rate (%/min)	0.06	0.06	0.06
	Time to failure (min)	331.7	333.3	333.3
	Strain at failure, ε_f (%)	19.90	20.00	20.00
	Filter paper correction	No	No	No
	Membrane correction	Yes	Yes	Yes
Measured specific gravity	3.134			

[a] Saturation set to 100% for phase calculations

Summary of strength parameters at peak deviator stress		
Total stress	c (psf)	0
	ϕ (deg)	27.5
Effective stress	c' (psf)	0
	ϕ' (deg)	37.3

Comments:

Due to the initial low density of the soil, test specimens were extruded directly into a latex membrane, placed in the triaxial chamber, and a vacuum applied. Measurements for the unit weight were taken after the vacuum had been applied. The vacuum removed some of the initial water and densified the specimen. Due to this setup procedure the initial dry unit weight and saturation may be erroneously high.

Tested by:___________

Reviewed:___________

Z:\PROJECTS\01640_CS_mining\001_Tailings\II\[GTXCU3v2_TAILINGS_BEACH_5_SURFACE.xls]Summary

Consolidated Undrained Triaxial Compression Test for Cohesive Soils

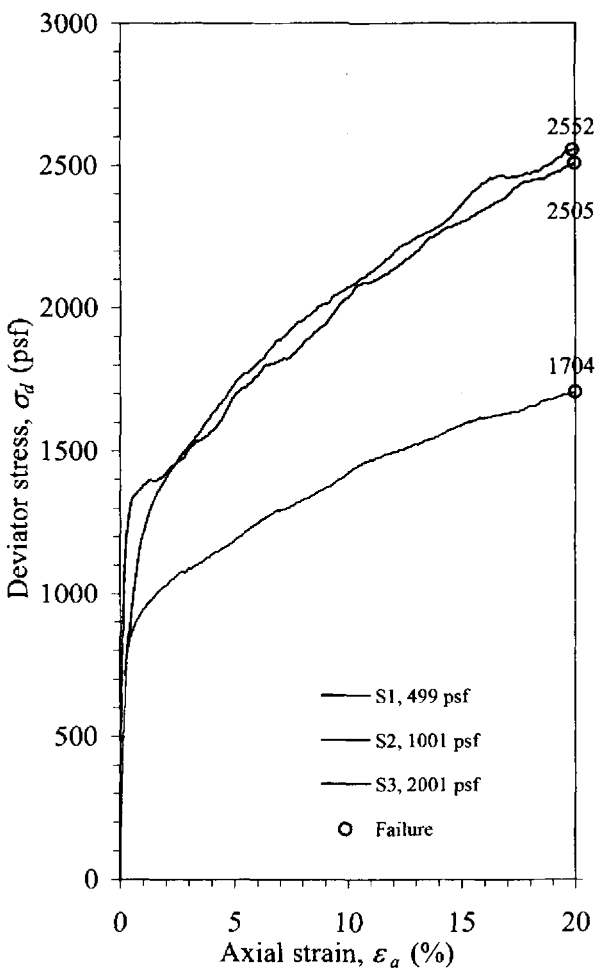
(*ASTM D4767*)

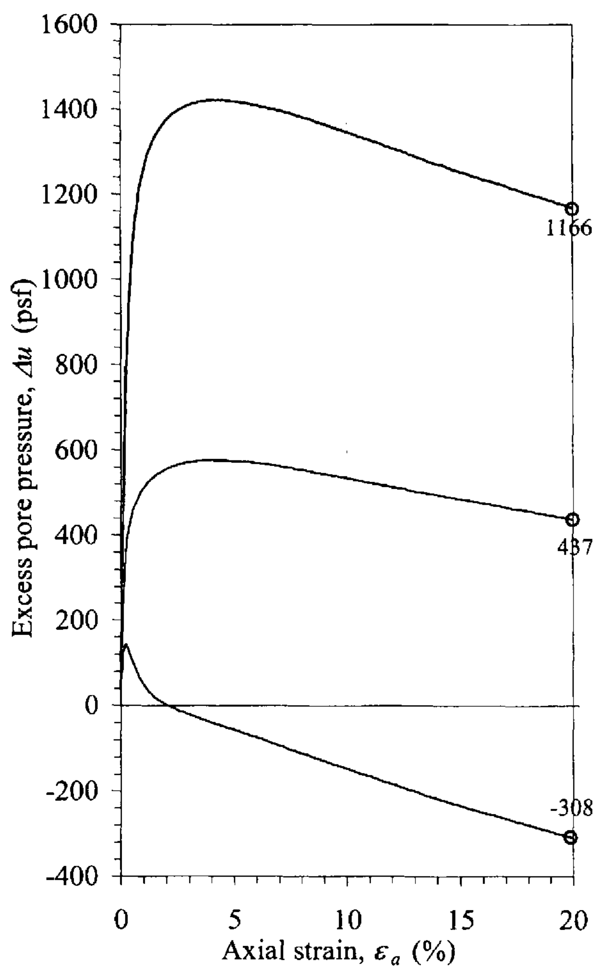
IGES

Project: CS Mining Existing Facility Expansion
No: 01640-001 (II)
Location: Milford, UT

Boring No.: Tailings Beach
Sample: 1, 3, & 5
Depth: Surface

	Test Number:	S1	S2	S3
Total stress	σ_3 (psf)	499	1001	2001
	σ_1-σ_3 (psf)	2552	1704	2505
	σ_1 (psf)	3051	2705	4506
	q = (σ_1-σ_3)/2 (psf)	1276	852	1253
	p = (σ_1+σ_3)/2 (psf)	1775	1853	3254
Effective stress	Δu (psf)	-308	437	1166
	σ'_3 (psf)	807	564	836
	σ'_1-σ'_3 (psf)	2552	1704	2505
	σ'_1 (psf)	3359	2268	3341
	q = (σ'_1-σ'_3)/2 (psf)	1276	852	1253
	p' = (σ'_1+σ'_3)/2 (psf)	2083	1416	2088
	σ'_1/σ'_3	4.16	4.02	4.00
	$A = \Delta u/(\sigma_1-\sigma_3)$	-0.121	0.256	0.465





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Consolidated Undrained Triaxial Compression Test for Cohesive Soils

(*ASTM D4767*)

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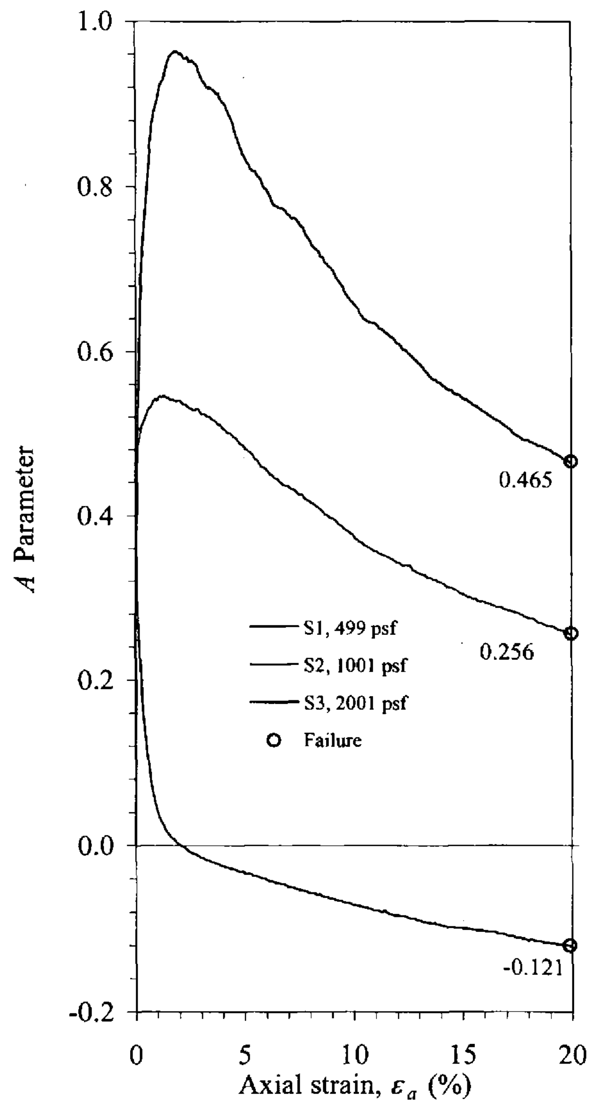
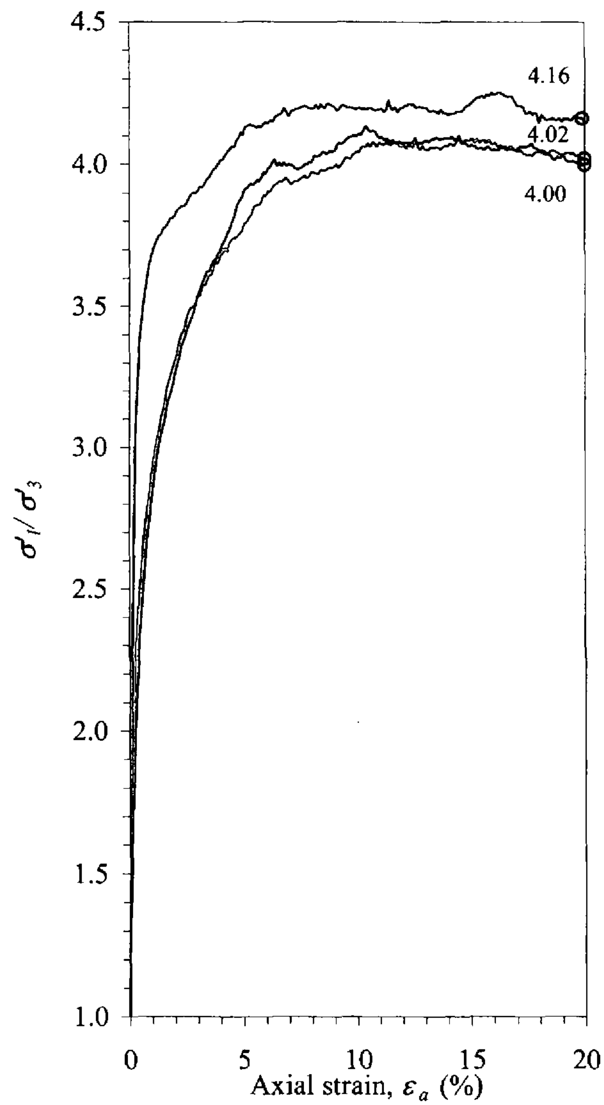
Project: CS Mining Existing Facility Expansion
No: 01640-001 (II)
Location: Milford, UT

Boring No.: Tailings Beach
Sample: 1, 3, & 5
Depth: Surface

Summary of strength parameters at peak deviator stress		
Total stress	c (psf)	0
	ϕ (deg)	27.5
Effective stress	c' (psf)	0
	ϕ' (deg)	37.3





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Consolidated Undrained Triaxial Compression Test for Cohesive Soils

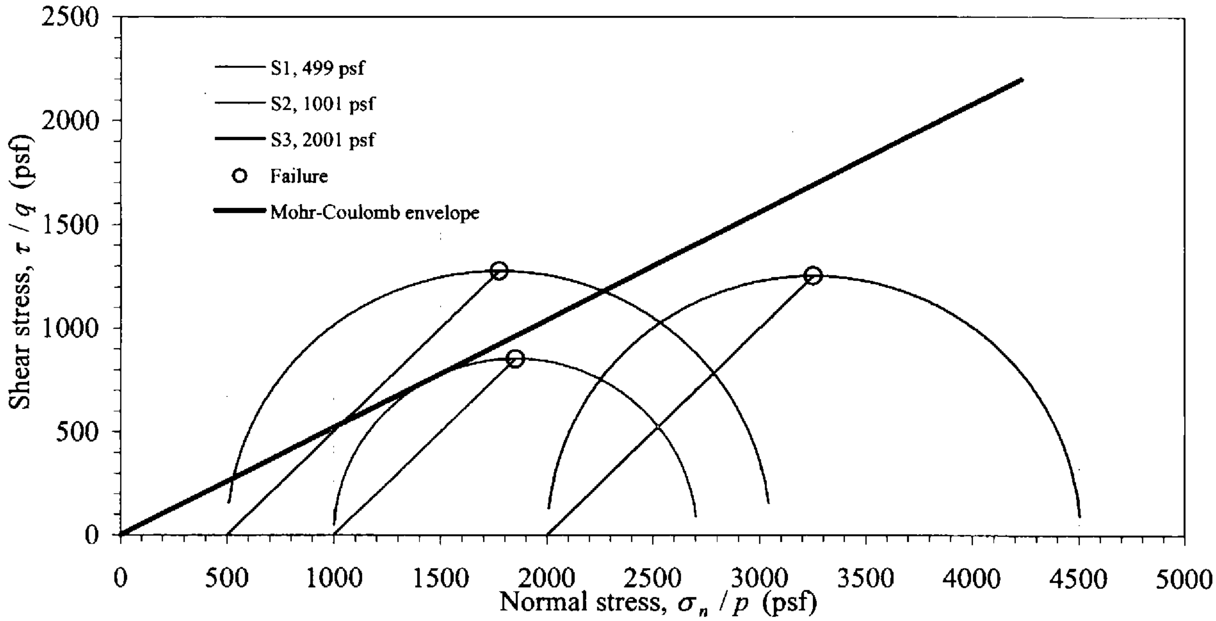
(*ASTM D4767*)

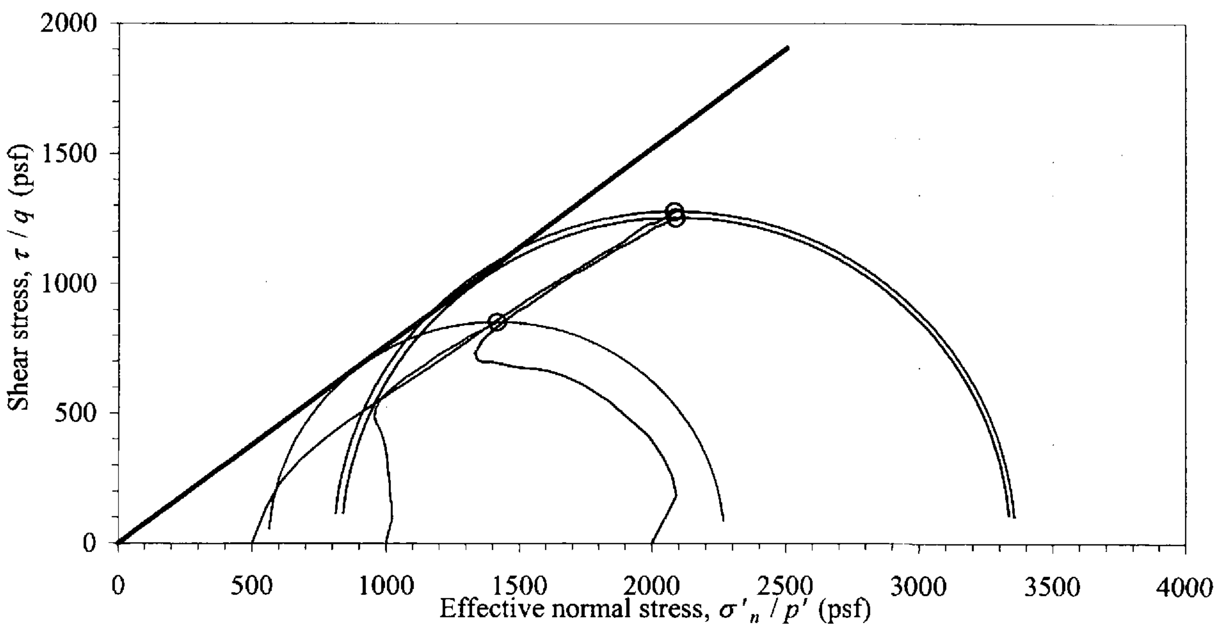
IGES

Project: CS Mining Existing Facility Expansion
No: 01640-001 (II)
Location: Milford, UT

Boring No.: Tailings Beach
Sample: 1, 3, & 5
Depth: Surface

Summary of strength parameters at peak deviator stress		
Total stress	c (psf)	0
	ϕ (deg)	27.5
Effective stress	c' (psf)	0
	ϕ' (deg)	37.3





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Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter, Method C (ASTM D5084)

IGES

Project: CS Mining Existing Facility Expansion
No: 01640-001 (II)
Location: Milford, UT
Date: 3/20/2013
By: JDF

Boring No.: TP-3
Sample:
Depth: 1-3'

Sample Description: Brown silty sand with gravel
Sample Type: Laboratory Compacted
Compaction Specifications: 95 (%) Dry unit weight at 12.3 (%) w

	Initial (o)	Final (f)
Sample Height, H (in)	3.010	3.001
Sample Diameter, D (in)	2.409	2.39
Sample Length, L (cm)	7.645	7.622
Sample Area, A (cm^2)	29.406	28.949
Sample Volume, V (cm^3)	224.82	220.64
Wt. Rings + Wet Soil (g)	491.1	500.21
Wt. Rings (g)	0	0
Wet Unit Wt., γ_m (pcf)	136.4	141.5
Wet Soil + Tare (g)	585.32	500.21
Dry Soil + Tare (g)	535.92	438.06
Tare (g)	127.9	0
Weight of solids, Ws (g)	438.06	438.06
Water Content, w (%)	12.11	14.19
Dry Unit Wt, γ_d (pcf)	121.6	123.9
Void ratio, e, for assumed Gs	0.36	0.38
Saturation (%), for assumed Gs	89.1	100 [a]
Average K[b] (cm/sec)	**2.3E-06**	

[a] Saturation set to 100% for phase calculations
[b] K corrected to 20°C

Optimum water content (%)	10.3	
Maximum dry unit weight (pcf)	127.5	
Gs	2.65	Assumed
Cell No.	1	
Station No.	1	
Permeant liquid used	De-aired tap water	
Total backpressure (psi)	34.5	
Effective horiz. consolidation stress (psi)	10.4	
Effective vert. consolidation stress (psi)	10.4	

	Initial (o)	Final (f)
B value	0.72	0.96
External Burette (cm^3)	9.30	20.20
Cell Pressure (psi)	0.0	44.9

Backpressure bottom (psi)	34.5
Backpressure top (psi)	34.5
System volume coefficient (cm^3/psi)	0.150
System volume change (cm^3)	6.72
Net sample volume change (cm^3)	-4.18
Bottom burette ground length, l_b (cm)	82.00
Top burette ground length, l_t (cm)	82.1
Burette area, a (cm^2)	0.197
Conversion, reading to cm head (cm/rd)	5.076

Start Date and Time: 3/18/13 12:58

Elapsed time (sec)	Bottom Burette (cm^3)	Top Burette (cm^3)	h_1 (cm)	h_2 (cm)	K (cm/sec)	Temp (°C)	Visc. Ratio R_f	K[b] (cm/sec)
4620.0	3.22 3.84	6.82 6.18	18.17	11.78	2.4E-06	21.3	0.97	2.4E-06
6240.0	0.00 2.20	10.00 7.78	50.66	28.22	2.4E-06	22.5	0.94	2.3E-06
4800.0	0.00 1.80	10.00 8.20	50.66	32.39	2.4E-06	19.7	1.01	2.4E-06
3480.0	1.80 2.62	8.20 7.38	32.39	24.06	2.2E-06	19.7	1.01	2.2E-06
4440.0	2.62 3.36	7.38 6.64	24.06	16.55	2.2E-06	19.4	1.02	2.2E-06

Entered by:__________
Reviewed:__________

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Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter, Method C (ASTM D5084)

IGES

Project: CS Mining Exisiting Facility Expansion
No: 01640-001 (II)
Location: Milford, UT
Date: 3/19/2013
By: MP

Boring No.: TP-6
Sample:
Depth: 2-3, 5-6'
Sample Description: Brown silty sand
Sample Type: Laboratory Compacted
Compaction Specifications: 95 (%) Dry unit weight
at 16.5 (%) w

	Initial (o)	Final (f)
Sample Height, H (in)	3.009	3.001
Sample Diameter, D (in)	2.407	2.39
Sample Length, L (cm)	7.643	7.623
Sample Area, A (cm^2)	29.357	28.971
Sample Volume, V (cm^3)	224.37	220.85
Wt. Rings + Wet Soil (g)	458.95	471.816
Wt. Rings (g)	0	0
Wet Unit Wt., γ_m (pcf)	127.7	133.4
Wet Soil + Tare (g)	494	598.57
Dry Soil + Tare (g)	441.55	520.28
Tare (g)	124.47	125.05
Weight of solids, Ws (g)	393.81	393.81
Water Content, w (%)	16.54	19.81
Dry Unit Wt, γ_d (pcf)	109.6	111.3
Void ratio, e, for assumed Gs	0.51	0.52
Saturation (%), for assumed Gs	86.0	100 [a]
Average K[b] (cm/sec)	**5.9E-05**	

[a] Saturation set to 100% for phase calculations
[b] K corrected to 20°C

Optimum water content (%)	14.5	
Maximum dry unit weight (pcf)	115.5	
Gs	2.65	Assumed
Cell No.	2	
Station No.	2	
Permeant liquid used	De-aired tap water	
Total backpressure (psi)	34.5	
Effective horiz. consolidation stress (psi)	10.4	
Effective vert. consolidation stress (psi)	10.4	

	Initial (o)	Final (f)
B value	0.54	1.00
External Burette (cm^3)	8.50	19.10
Cell Pressure (psi)	0.0	44.9

Backpressure bottom (psi)	34.5
Backpressure top (psi)	34.5
System volume coefficient (cm^3/psi)	0.158
System volume change (cm^3)	7.08
Net sample volume change (cm^3)	-3.52
Bottom burette ground length, l_b (cm)	81.99
Top burette ground length, l_t (cm)	81.97
Burette area, a (cm^2)	0.197
Conversion, reading to cm head (cm/rd)	5.076

Start Date and Time: 3/18/13 13:00

Elapsed time (sec)	Bottom Burette (cm^3)	Top Burette (cm^3)	h_1 (cm)	h_2 (cm)	K (cm/sec)	Temp (°C)	Visc. Ratic R_f	K^b (cm/sec)
420.0	0.08 3.26	9.94 6.74	50.07	17.68	6.4E-05	22.1	0.95	6.1E-05
420.0	0.00 3.20	10.00 6.76	50.78	18.09	6.4E-05	22.1	0.95	6.1E-05
420.0	0.00 3.18	10.00 6.78	50.78	18.29	6.3E-05	22.1	0.95	6.0E-05
420.0	0.00 3.14	10.00 6.82	50.78	18.70	6.2E-05	22.1	0.95	5.9E-05
420.0	0.00 3.10	9.94 6.84	50.48	19.00	6.0E-05	22.1	0.95	5.7E-05

Entered by:___________
Reviewed:___________

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Water Content and Unit Weight of Soil

(In General Accordance with ASTM D7263 Method B and D2216)

IGES

Project: CS Mining Existing Facility Expansion
No: 01640-001 (II)
Location: Milford, UT
Date: 3/15/2013
By: JDF

Sample Info.	Boring No.	Tailings Beach	Tailings Beach	Tailings Beach	Tailings Beach				
	Sample:	2	4	6	8				
	Depth:	Surface	Surface	Surface	Surface				
Unit Weight Info.	Sample height, H (in)	5.970	6.000	5.363	5.363				
	Sample diameter, D (in)	2.416	2.416	2.416	2.416				
	Sample volume, V (ft^3)	0.0158	0.0159	0.0142	0.0142				
	Mass rings + wet soil (g)	1168.96	1924.20	1840.10	1838.40				
	Mass rings/tare (g)	250.38	1008.29	1013.96	1014.37				
	Moist soil, Ws (g)	918.58	915.91	826.14	824.03				
	Moist unit wt., γ_m (pcf)	127.86	126.85	128.01	127.68				
Water Content	Wet soil + tare (g)	1041.51	1036.07	954.42	959.71				
	Dry soil + tare (g)	827.07	818.84	756.58	763.40				
	Tare (g)	127.01	124.10	129.29	140.35				
Water Content, w (%)		**30.6**	**31.3**	**31.5**	**31.5**				
Dry Unit Wt., γ_d (pcf)		**97.9**	**96.6**	**97.3**	**97.1**				

Entered by:__________

Reviewed:__________

Liquid Limit, Plastic Limit, and Plasticity Index of Soils

(ASTM D4318)

IGES

Project: CS Mining Existing Facility Expansion
No: 01640-001 (II)
Location: Milford, UT
Date: 3/13/2013
By: DKS

Boring No.: TP-3
Sample: Combined Samples
Depth: 1-3'
Description: Brown silty sand

Preparation method: Air Dry
Liquid Limit: Could not be determined (N.P.)

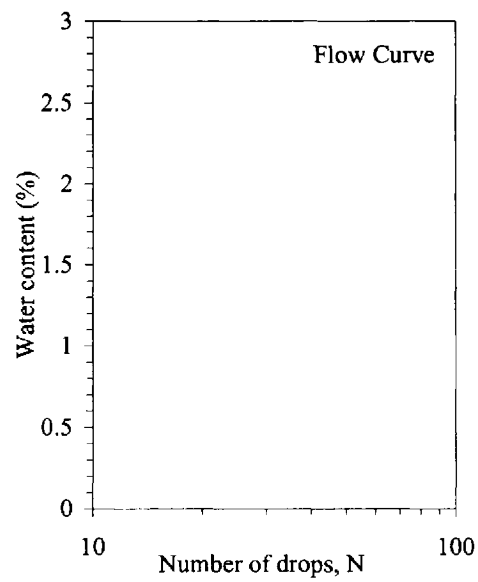
Plastic Limit

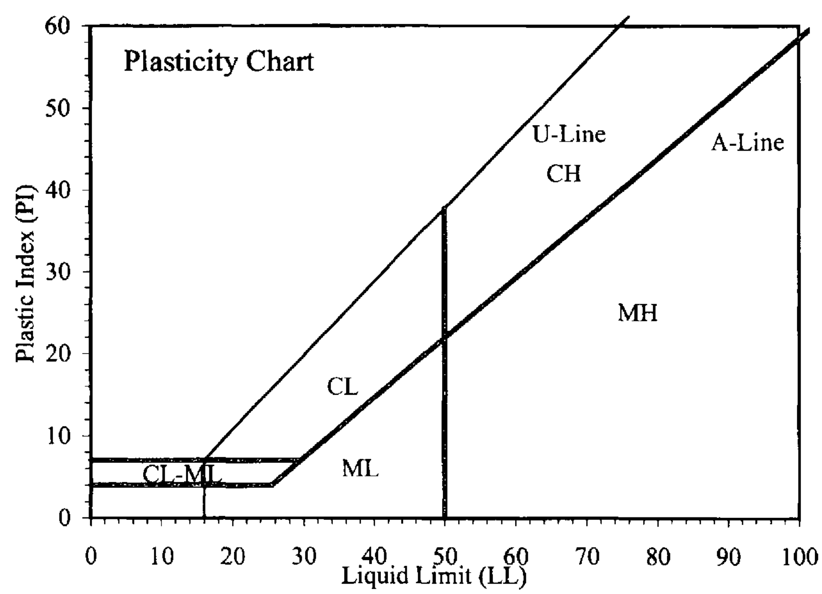
Determination No						
Wet Soil + Tare (g)						
Dry Soil + Tare (g)		Difficult to thread.				
Water Loss (g)						
Tare (g)						
Dry Soil (g)						
Water Content, w (%)						

Liquid Limit: Could not be determined (N.P.)

Determination No						
Number of Drops, N						
Wet Soil + Tare (g)	Unable to obtain an adequate blow count.					
Dry Soil + Tare (g)						
Water Loss (g)						
Tare (g)						
Dry Soil (g)						
Water Content, w (%)						
One-Point LL (%)						

Liquid Limit, LL (%)	**Nonplastic (N.P.)**
Plastic Limit, PL (%)	
Plasticity Index, PI (%)	





Entered by:___________
Reviewed:___________

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Liquid Limit, Plastic Limit, and Plasticity Index of Soils

(ASTM D4318)

IGES

Project: CS Mining Existing Facility Expansion
No: 01640-001 (II)
Location: Milford, UT
Date: 3/19/2013
By: DKS

Boring No.: TP-4
Sample:
Depth: 3-5'
Description: Brown lean clay

Preparation method: Air Dry
Liquid limit test method: Multipoint

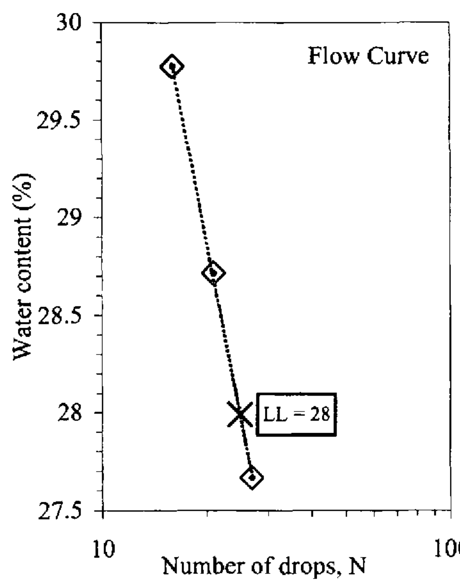
Plastic Limit

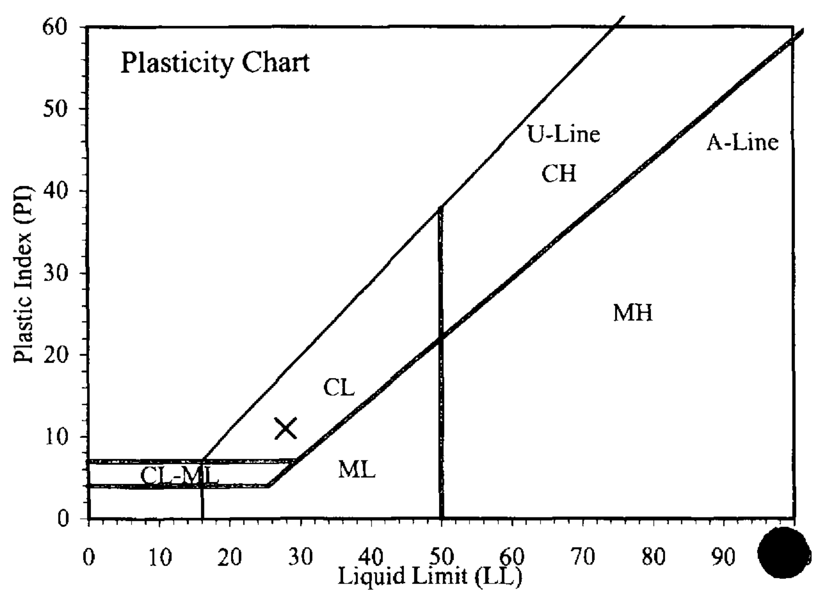
Determination No	1	2				
Wet Soil + Tare (g)	34.48	35.42				
Dry Soil + Tare (g)	32.69	33.50				
Water Loss (g)	1.79	1.92				
Tare (g)	21.88	21.97				
Dry Soil (g)	10.81	11.53				
Water Content, w (%)	16.56	16.65				

Liquid Limit

Determination No	1	2	3			
Number of Drops, N	27	21	16			
Wet Soil + Tare (g)	36.86	35.84	37.70			
Dry Soil + Tare (g)	33.62	32.73	34.02			
Water Loss (g)	3.24	3.11	3.68			
Tare (g)	21.91	21.90	21.66			
Dry Soil (g)	11.71	10.83	12.36			
Water Content, w (%)	27.67	28.72	29.77			
One-Point LL (%)	28	28				

Liquid Limit, LL (%)	**28**
Plastic Limit, PL (%)	**17**
Plasticity Index, PI (%)	**11**





Entered by:__________
Reviewed:__________

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Liquid Limit, Plastic Limit, and Plasticity Index of Soils
(ASTM D4318)

IGES

Project: **CS Mining Existing Facility Expansion**
No: **01640-001 (II)**
Location: Milford, UT
Date: 3/19/2013
By: DKS

Boring No.: **TP-4**
Sample:
Depth: **5-6'**
Description: Brown lean clay

Preparation method: Air Dry
Liquid limit test method: Multipoint

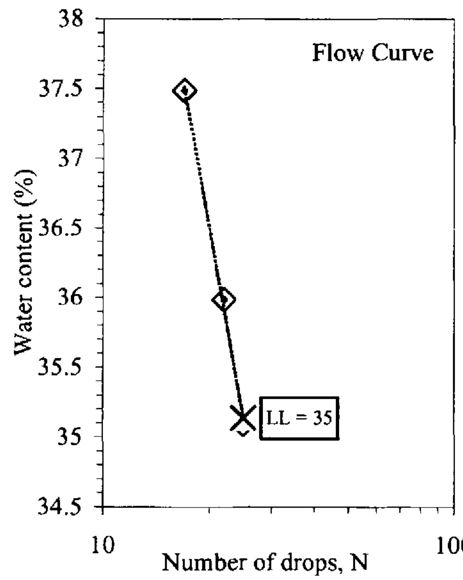
Plastic Limit

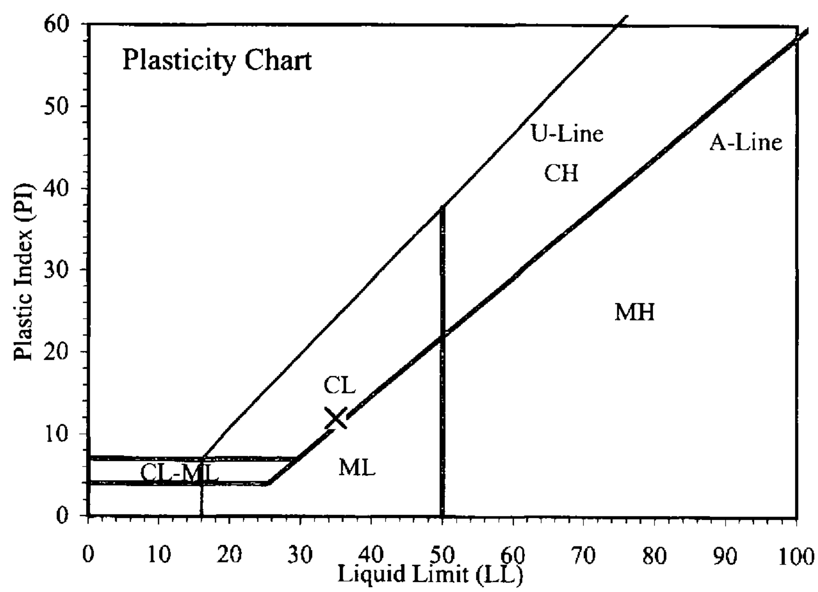
Determination No	1	2				
Wet Soil + Tare (g)	37.58	38.16				
Dry Soil + Tare (g)	34.61	35.05				
Water Loss (g)	2.97	3.11				
Tare (g)	21.55	21.47				
Dry Soil (g)	13.06	13.58				
Water Content, w (%)	22.74	22.90				

Liquid Limit

Determination No	1	2	3			
Number of Drops, N	25	22	17			
Wet Soil + Tare (g)	34.79	34.76	35.72			
Dry Soil + Tare (g)	31.40	31.28	31.90			
Water Loss (g)	3.39	3.48	3.82			
Tare (g)	21.74	21.61	21.71			
Dry Soil (g)	9.66	9.67	10.19			
Water Content, w (%)	35.09	35.99	37.49			
One-Point LL (%)	35	35				

Liquid Limit, LL (%)	**35**
Plastic Limit, PL (%)	**23**
Plasticity Index, PI (%)	**12**





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Liquid Limit, Plastic Limit, and Plasticity Index of Soils
(ASTM D4318)

IGES

Project: CS Mining Existing Facility Expansion
No: 01640-001 (II)
Location: Milford, UT
Date: 3/19/2013
By: DKS

Boring No.: TP-5
Sample: Combined Samples
Depth: 3-4' & 6'
Description: Brown silty sand

Preparation method: Air Dry
Liquid Limit: Could not be determined (N.P.)

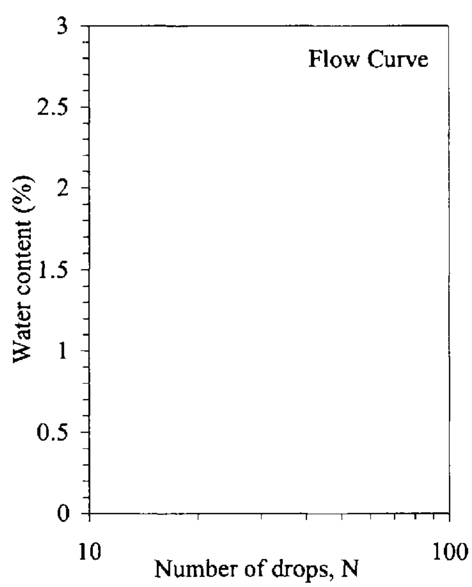
Plastic Limit

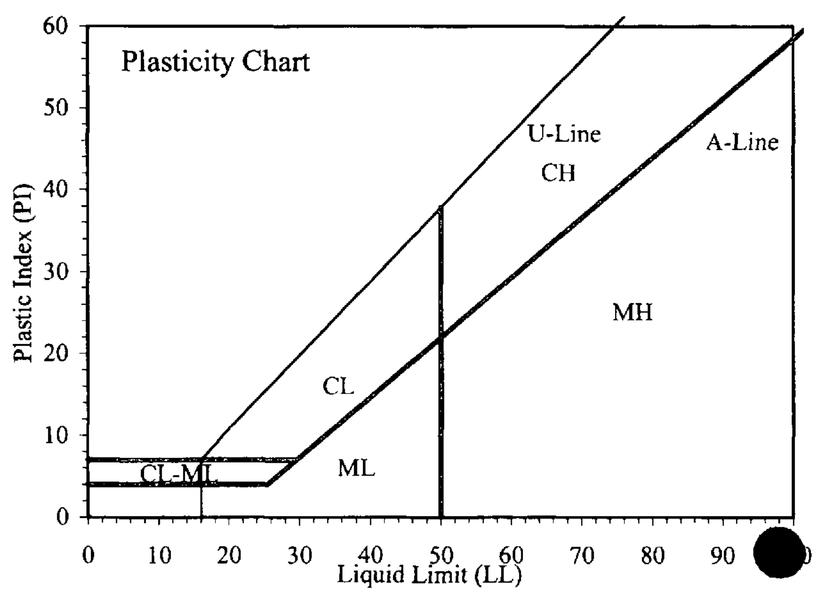
Determination No						
Wet Soil + Tare (g)						
Dry Soil + Tare (g)		Difficult to thread.				
Water Loss (g)						
Tare (g)						
Dry Soil (g)						
Water Content, w (%)						

Liquid Limit: Could not be determined (N.P.)

Determination No						
Number of Drops, N						
Wet Soil + Tare (g)						
Dry Soil + Tare (g)	Unable to obtain an adequate blow count.					
Water Loss (g)						
Tare (g)						
Dry Soil (g)						
Water Content, w (%)						
One-Point LL (%)						

Liquid Limit, LL (%)	**Nonplastic (N.P.)**
Plastic Limit, PL (%)	
Plasticity Index, PI (%)	





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Liquid Limit, Plastic Limit, and Plasticity Index of Soils

(ASTM D4318)

IGES

Project: CS Mining Existing Facility Expansion
No: 01640-001 (II)
Location: Milford, UT
Date: 3/13/2013
By: DKS

Boring No.: TP-6
Sample: Combined Samples
Depth: 2-3' & 5-6'
Description: Brown silt

Preparation method: Air Dry
Liquid Limit: Could not be determined (N.P.)

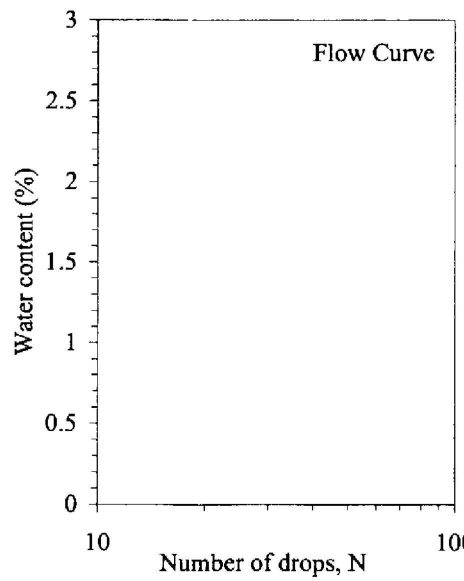
Plastic Limit

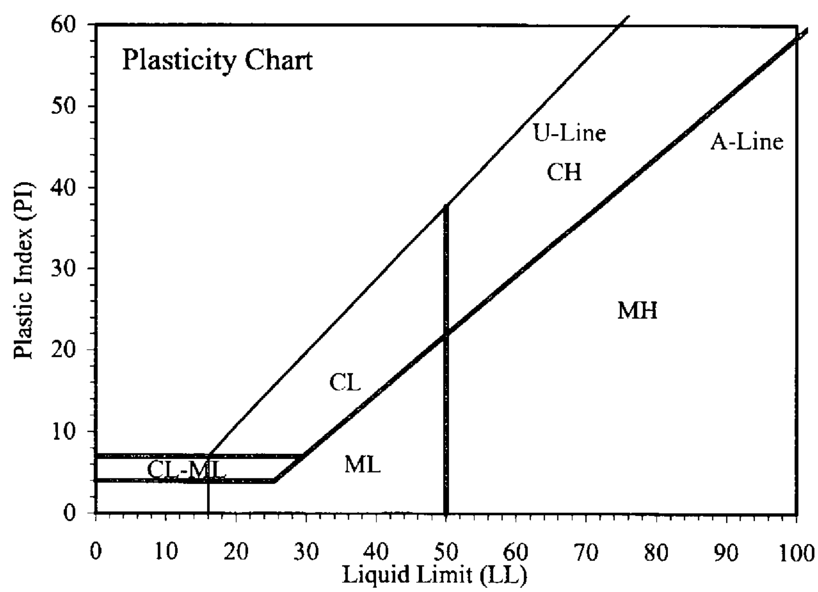
Determination No						
Wet Soil + Tare (g)						
Dry Soil + Tare (g)	Difficult to thread.					
Water Loss (g)						
Tare (g)						
Dry Soil (g)						
Water Content, w (%)						

Liquid Limit: Could not be determined (N.P.)

Determination No						
Number of Drops, N						
Wet Soil + Tare (g)	Unable to obtain an adequate blow count.					
Dry Soil + Tare (g)						
Water Loss (g)						
Tare (g)						
Dry Soil (g)						
Water Content, w (%)						
One-Point LL (%)						

Liquid Limit, LL (%)	**Nonplastic (N.P.)**
Plastic Limit, PL (%)	
Plasticity Index, PI (%)	





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Liquid Limit, Plastic Limit, and Plasticity Index of Soils

(ASTM D4318)

IGES

Project: CS Mining Existing Facility Expansion
No: 01640-001 (II)
Location: Milford, UT
Date: 3/19/2013
By: DKS

Boring No.: TP-7
Sample:
Depth: 2-3'
Description: Brown silty sand

Preparation method: Air Dry
Liquid Limit: Could not be determined (N.P.)

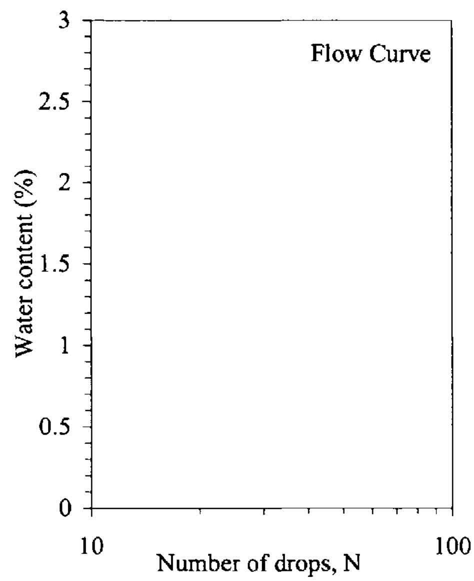
Plastic Limit

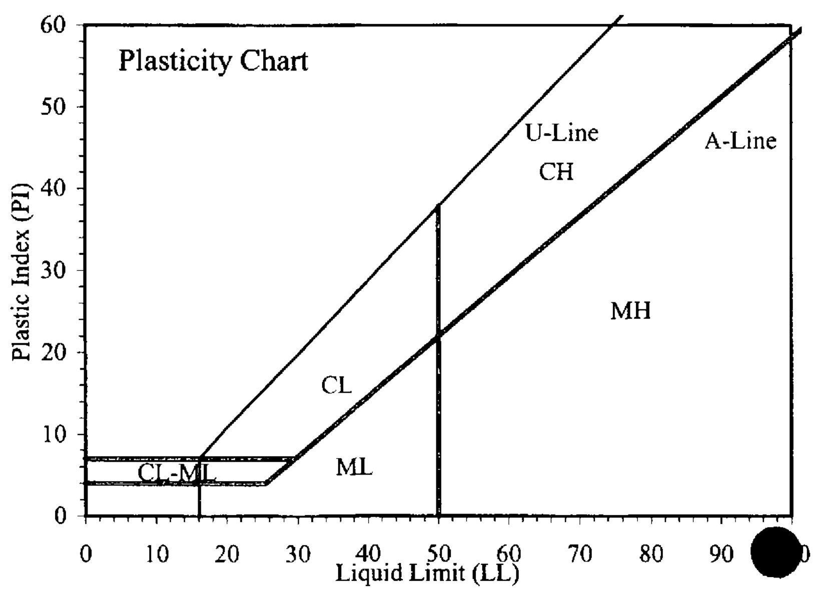
Determination No						
Wet Soil + Tare (g)						
Dry Soil + Tare (g)		Difficult to thread.				
Water Loss (g)						
Tare (g)						
Dry Soil (g)						
Water Content, w (%)						

Liquid Limit: Could not be determined (N.P.)

Determination No						
Number of Drops, N						
Wet Soil + Tare (g)						
Dry Soil + Tare (g)	Unable to obtain an adequate blow count.					
Water Loss (g)						
Tare (g)						
Dry Soil (g)						
Water Content, w (%)						
One-Point LL (%)						

Liquid Limit, LL (%)	**Nonplastic (N.P.)**
Plastic Limit, PL (%)	
Plasticity Index, PI (%)	





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Liquid Limit, Plastic Limit, and Plasticity Index of Soils
(ASTM D4318)

IGES

Project: **CS Mining Existing Facility Expansion**
No: **01640-001 (II)**
Location: Milford, UT
Date: 3/19/2013
By: DKS

Boring No.: **TP-8**
Sample:
Depth: **3-4'**
Description: Brown silty sand

Preparation method: Air Dry
Liquid Limit: Could not be determined (N.P.)

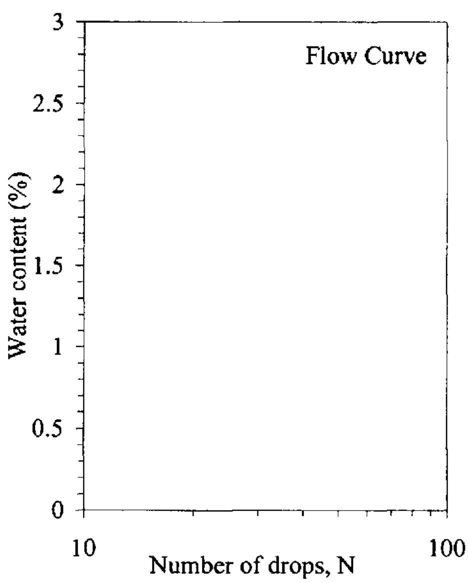
Plastic Limit

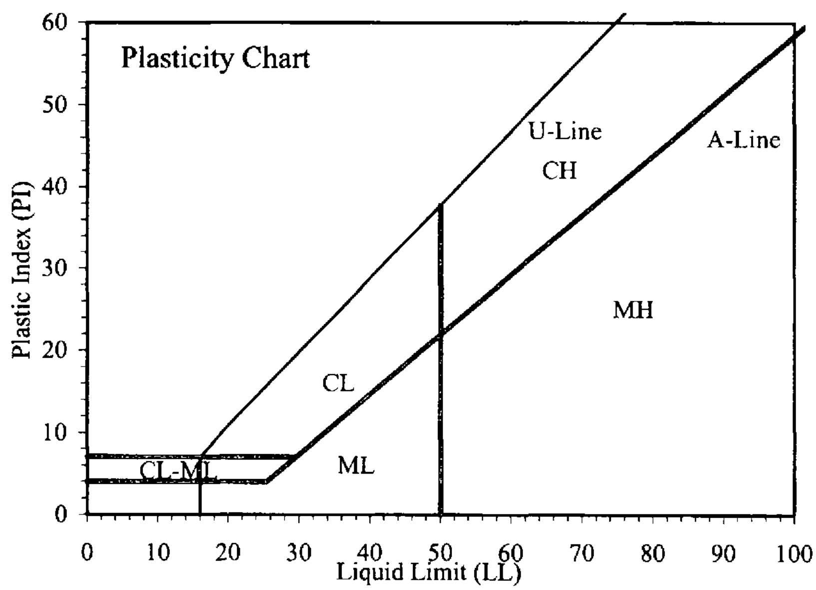
Determination No						
Wet Soil + Tare (g)						
Dry Soil + Tare (g)		Difficult to thread.				
Water Loss (g)						
Tare (g)						
Dry Soil (g)						
Water Content, w (%)						

Liquid Limit: Could not be determined (N.P.)

Determination No						
Number of Drops, N						
Wet Soil + Tare (g)						
Dry Soil + Tare (g)	Unable to obtain an adequate blow count.					
Water Loss (g)						
Tare (g)						
Dry Soil (g)						
Water Content, w (%)						
One-Point LL (%)						

Liquid Limit, LL (%)	**Nonplastic (N.P.)**
Plastic Limit, PL (%)	
Plasticity Index, PI (%)	





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Liquid Limit, Plastic Limit, and Plasticity Index of Soils

(ASTM D4318)

IGES

Project: CS Mining Existing Facility Expansion
No: 01640-001 (II)
Location: Milford, UT
Date: 3/19/2013
By: DKS

Boring No.: TP-9
Sample:
Depth: 3-4'
Description: Brown silty sand

Preparation method: Air Dry
Liquid Limit: Could not be determined (N.P.)

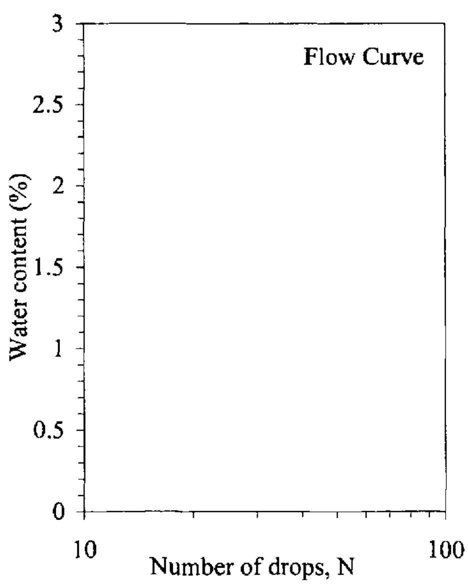
Plastic Limit

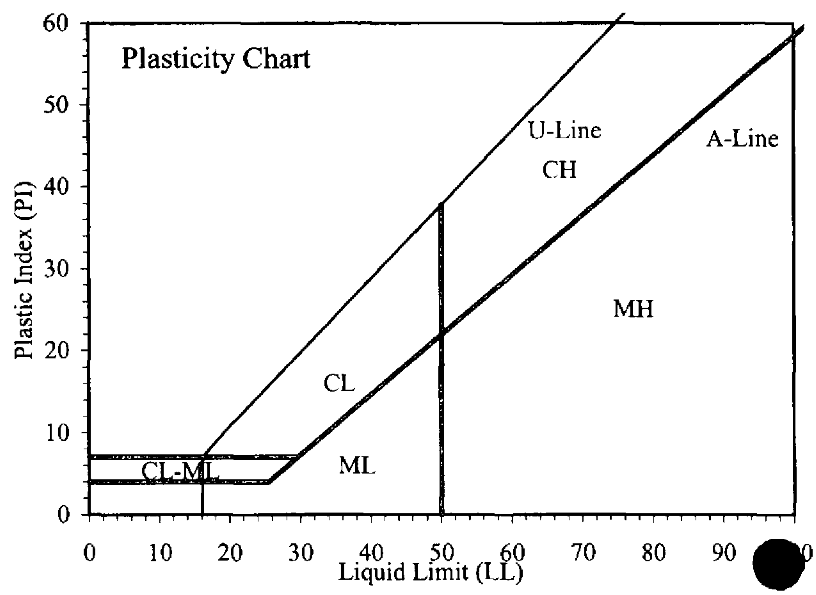
Determination No						
Wet Soil + Tare (g)						
Dry Soil + Tare (g)		Difficult to thread.				
Water Loss (g)						
Tare (g)						
Dry Soil (g)						
Water Content, w (%)						

Liquid Limit: Could not be determined (N.P.)

Determination No						
Number of Drops, N						
Wet Soil + Tare (g)						
Dry Soil + Tare (g)	Unable to obtain an adequate blow count.					
Water Loss (g)						
Tare (g)						
Dry Soil (g)						
Water Content, w (%)						
One-Point LL (%)						

Liquid Limit, LL (%)	**Nonplastic (N.P.)**
Plastic Limit, PL (%)	
Plasticity Index, PI (%)	





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Liquid Limit, Plastic Limit, and Plasticity Index of Soils

(ASTM D4318)

IGES

Project: CS Mining Existing Facility Expansion
No: 01640-001 (II)
Location: Milford, UT
Date: 3/20/2013
By: DKS

Boring No.: Tailings Beach
Sample: 1
Depth: Surface
Description: Dark grey silty sand

Preparation method: Air Dry
Liquid Limit: Could not be determined (N.P.)

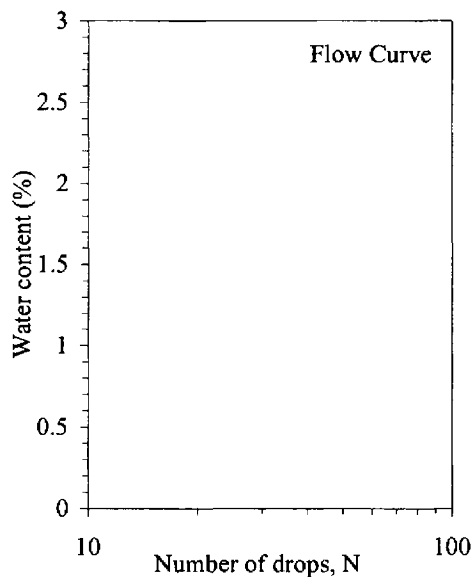
Plastic Limit

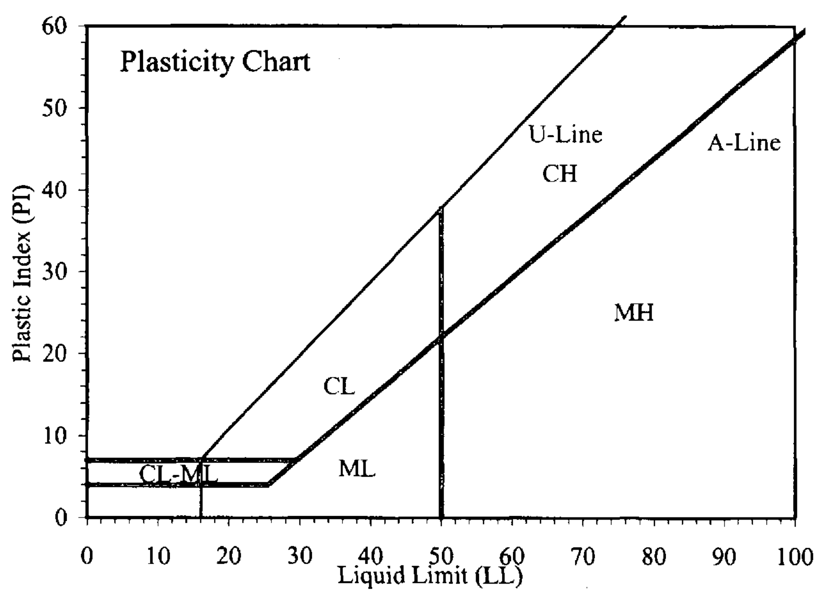
Determination No						
Wet Soil + Tare (g)						
Dry Soil + Tare (g)		Difficult to thread.				
Water Loss (g)						
Tare (g)						
Dry Soil (g)						
Water Content, w (%)						

Liquid Limit: Could not be determined (N.P.)

Determination No						
Number of Drops, N						
Wet Soil + Tare (g)						
Dry Soil + Tare (g)	Unable to obtain an adequate blow count.					
Water Loss (g)						
Tare (g)						
Dry Soil (g)						
Water Content, w (%)						
One-Point LL (%)						

Liquid Limit, LL (%)	**Nonplastic (N.P.)**
Plastic Limit, PL (%)	
Plasticity Index, PI (%)	





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Liquid Limit, Plastic Limit, and Plasticity Index of Soils

(ASTM D4318)

Project: CS Mining Existing Facility Expansion
No: 01640-001 (II)
Location: Milford, UT
Date: 3/20/2013
By: DKS

Boring No.: Tailings Beach
Sample: 3
Depth: Surface
Description: Dark grey silty sand

Preparation method: Air Dry
Liquid Limit: Could not be determined (N.P.)

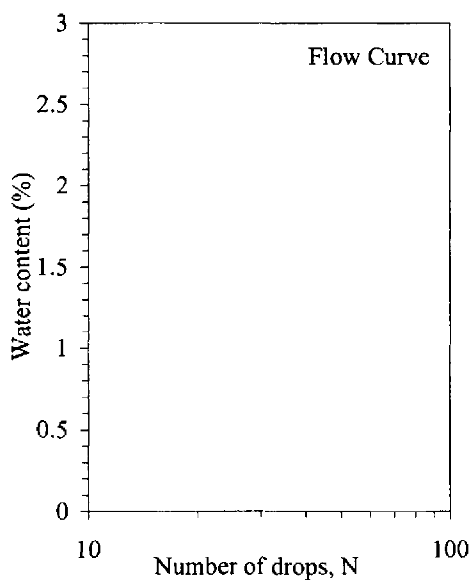
Plastic Limit

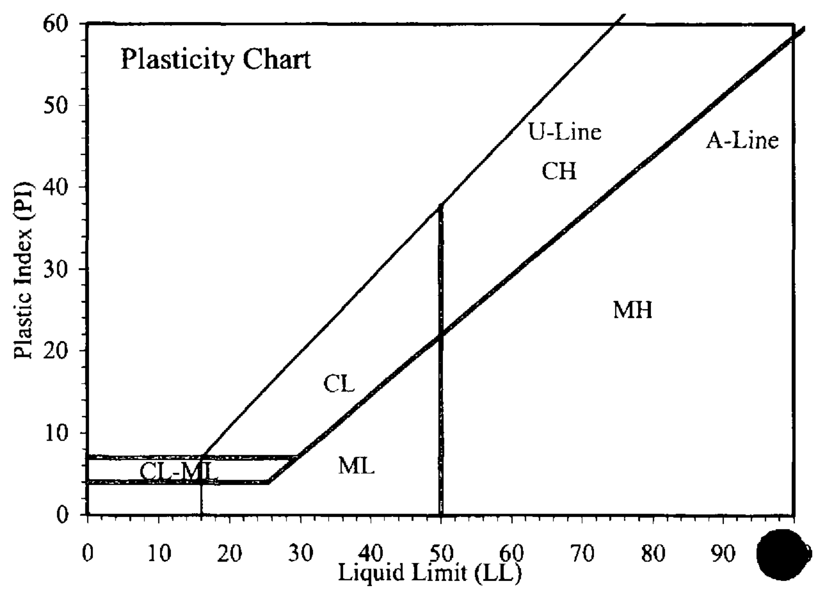
Determination No						
Wet Soil + Tare (g)						
Dry Soil + Tare (g)		Difficult to thread.				
Water Loss (g)						
Tare (g)						
Dry Soil (g)						
Water Content, w (%)						

Liquid Limit: Could not be determined (N.P.)

Determination No						
Number of Drops, N						
Wet Soil + Tare (g)						
Dry Soil + Tare (g)	Unable to obtain an adequate blow count.					
Water Loss (g)						
Tare (g)						
Dry Soil (g)						
Water Content, w (%)						
One-Point LL (%)						

Liquid Limit, LL (%)	**Nonplastic (N.P.)**
Plastic Limit, PL (%)	
Plasticity Index, PI (%)	





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Liquid Limit, Plastic Limit, and Plasticity Index of Soils

(ASTM D4318)

IGES

Project: CS Mining Existing Facility Expansion
No: 01640-001 (II)
Location: Milford, UT
Date: 3/20/2013
By: DKS

Boring No.: Tailings Beach
Sample: 5
Depth: Surface
Description: Dark grey silty sand

Preparation method: Air Dry
Liquid Limit: Could not be determined (N.P.)

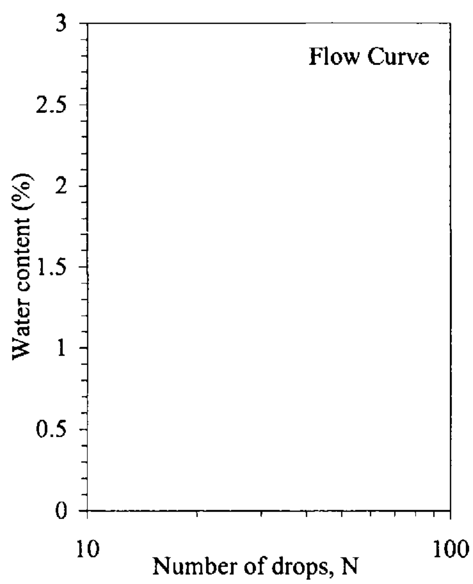
Plastic Limit

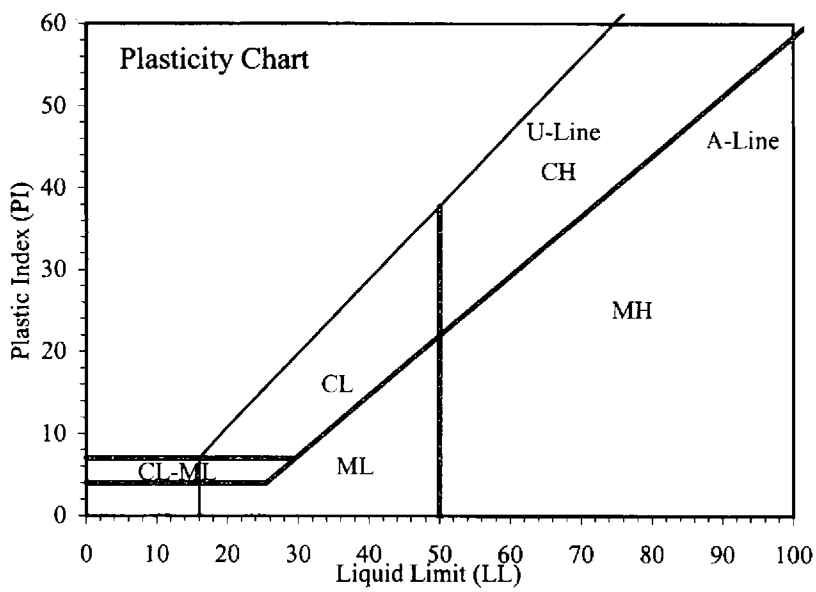
Determination No						
Wet Soil + Tare (g)						
Dry Soil + Tare (g)		Difficult to thread.				
Water Loss (g)						
Tare (g)						
Dry Soil (g)						
Water Content, w (%)						

Liquid Limit: Could not be determined (N.P.)

Determination No						
Number of Drops, N						
Wet Soil + Tare (g)						
Dry Soil + Tare (g)	Unable to obtain an adequate blow count.					
Water Loss (g)						
Tare (g)						
Dry Soil (g)						
Water Content, w (%)						
One-Point LL (%)						

Liquid Limit, LL (%)	**Nonplastic (N.P.)**
Plastic Limit, PL (%)	
Plasticity Index, PI (%)	





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Liquid Limit, Plastic Limit, and Plasticity Index of Soils

(ASTM D4318)

IGES

Project: CS Mining Existing Facility Expansion
No: 01640-001 (II)
Location: Milford, UT
Date: 3/19/2013
By: DKS

Boring No.: Tailings Beach
Sample: 7
Depth: Surface
Description: Dark grey silty sand

Preparation method: Air Dry
Liquid Limit: Could not be determined (N.P.)

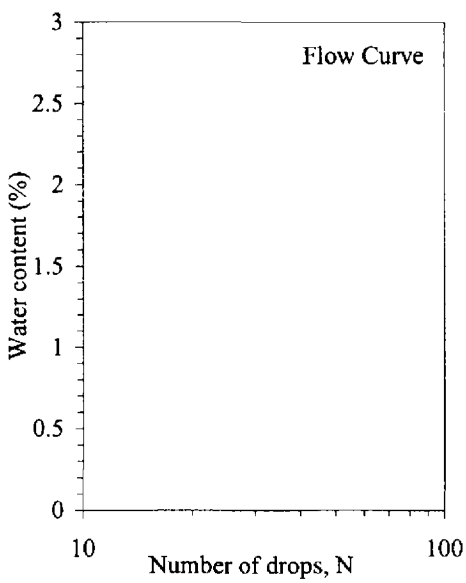
Plastic Limit

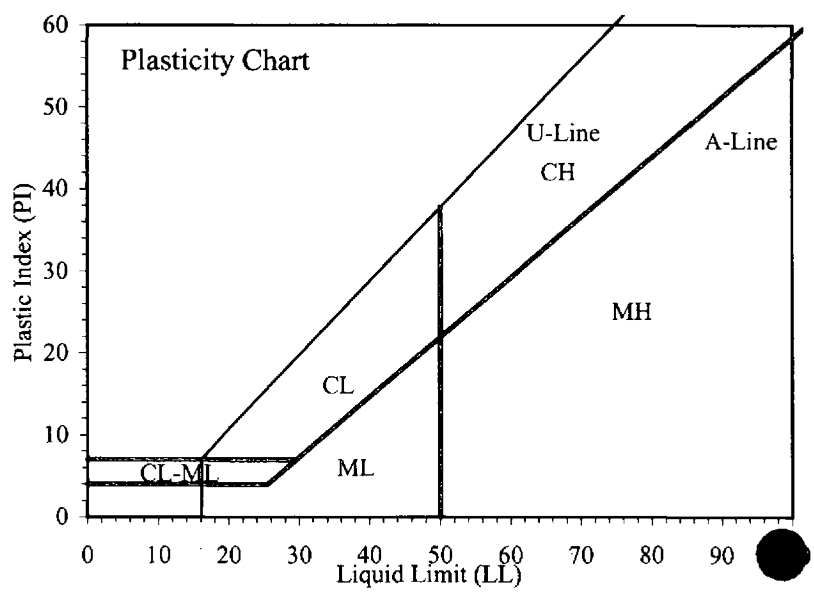
Determination No						
Wet Soil + Tare (g)						
Dry Soil + Tare (g)		Difficult to thread.				
Water Loss (g)						
Tare (g)						
Dry Soil (g)						
Water Content, w (%)						

Liquid Limit: Could not be determined (N.P.)

Determination No						
Number of Drops, N						
Wet Soil + Tare (g)						
Dry Soil + Tare (g)	Unable to obtain an adequate blow count.					
Water Loss (g)						
Tare (g)						
Dry Soil (g)						
Water Content, w (%)						
One-Point LL (%)						

Liquid Limit, LL (%)	**Nonplastic (N.P.)**
Plastic Limit, PL (%)	
Plasticity Index, PI (%)	





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Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis

(ASTM D6913)

IGES

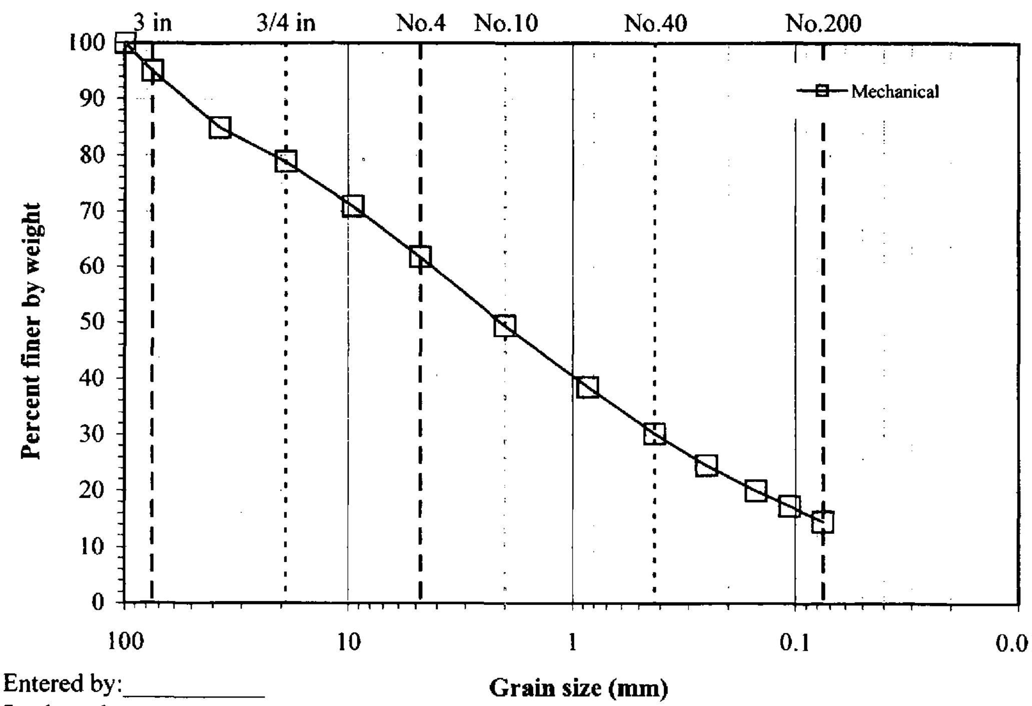
Project: CS Mining Existing Facility Expansion
No: 01640-001 (II)
Location: Milford, UT
Date: 3/13/2013
By: BRR

Boring No.: TP-3
Sample: Combined Samples
Depth: 1-3'
Description: Brown silty sand with gravel

Split:	Yes	
Split sieve:	3/4"	
	Moist	Dry
Total sample wt. (g):	51492.80	49124.9
+3/4" Coarse fraction (g):	10584.6	10420.4
-3/4" Split fraction (g):	1428.46	1351.51
Split fraction:	0.788	

Water content data	C.F.(+3/4")	S.F.(-3/4")
Moist soil + tare (g):	1382.89	1837.27
Dry soil + tare (g):	1364.78	1760.32
Tare (g):	215.39	408.81
Water content (%):	1.6	5.7

Sieve	Accum. Wt. Ret. (g)	Grain Size (mm)	Percent Finer	
8"	-	200	-	
6"	-	150	-	
4"	-	100	100.0	
3"	2486.62	75	94.9	
1.5"	7432.20	37.5	84.9	
3/4"	10420.41	19	78.8	←Split
3/8"	135.15	9.5	70.9	
No.4	292.17	4.75	61.8	
No.10	504.60	2	49.4	
No.20	692.94	0.85	38.4	
No.40	832.15	0.425	30.3	
No.60	930.44	0.25	24.5	
No.100	1008.26	0.15	20.0	
No.140	1054.23	0.106	17.3	
No.200	1101.47	0.075	14.6	



Gravel (%): 38.2
Sand (%): 47.2
Fines (%): 14.6

Entered by:__________
Reviewed:__________

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Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis

(ASTM D6913)

IGES

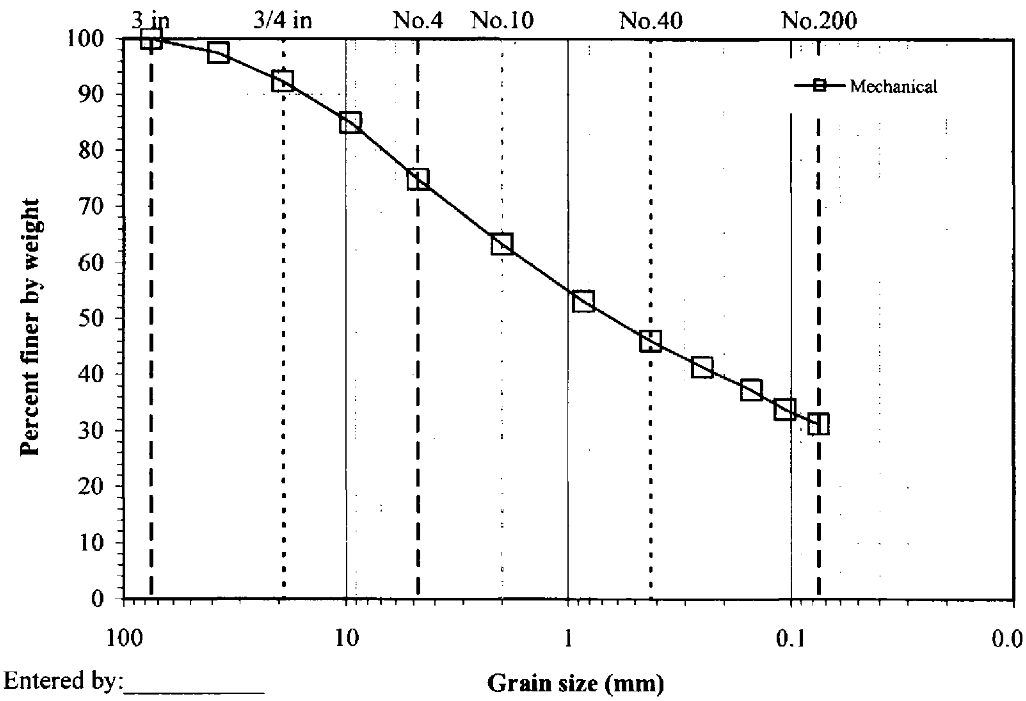
Project: CS Mining Existing Facility Expansion
No: 01640-001 (II)
Location: Milford, UT
Date: 3/19/2013
By: BRR

Boring No.: TP-4
Sample:
Depth: 3-5'
Description: Brown clayey sand with gravel

Split:	Yes	
Split sieve:	3/4"	
	Moist	Dry
Total sample wt. (g):	24749.68	23534.9
+3/4" Coarse fraction (g):	1814.48	1790.9
-3/4" Split fraction (g):	1493.41	1415.85
Split fraction:	0.924	

Water content data	C.F.(+3/4")	S.F.(-3/4")
Moist soil + tare (g):	2026.03	1901.93
Dry soil + tare (g):	2002.42	1824.37
Tare (g):	211.56	408.52
Water content (%):	1.3	5.5

Sieve	Accum. Wt. Ret. (g)	Grain Size (mm)	Percent Finer	
8"	-	200	-	
6"	-	150	-	
4"	-	100	-	
3"	-	75	100.0	
1.5"	619.31	37.5	97.4	
3/4"	1790.87	19	92.4	←Split
3/8"	114.98	9.5	84.9	
No.4	268.60	4.75	74.9	
No.10	446.53	2	63.3	
No.20	603.06	0.85	53.0	
No.40	709.62	0.425	46.1	
No.60	782.82	0.25	41.3	
No.100	844.50	0.15	37.3	
No.140	897.82	0.106	33.8	
No.200	937.22	0.075	31.2	



Gravel (%): 25.1
Sand (%): 43.6
Fines (%): 31.2

Entered by:__________
Reviewed:__________

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Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis

(ASTM D6913)

IGES

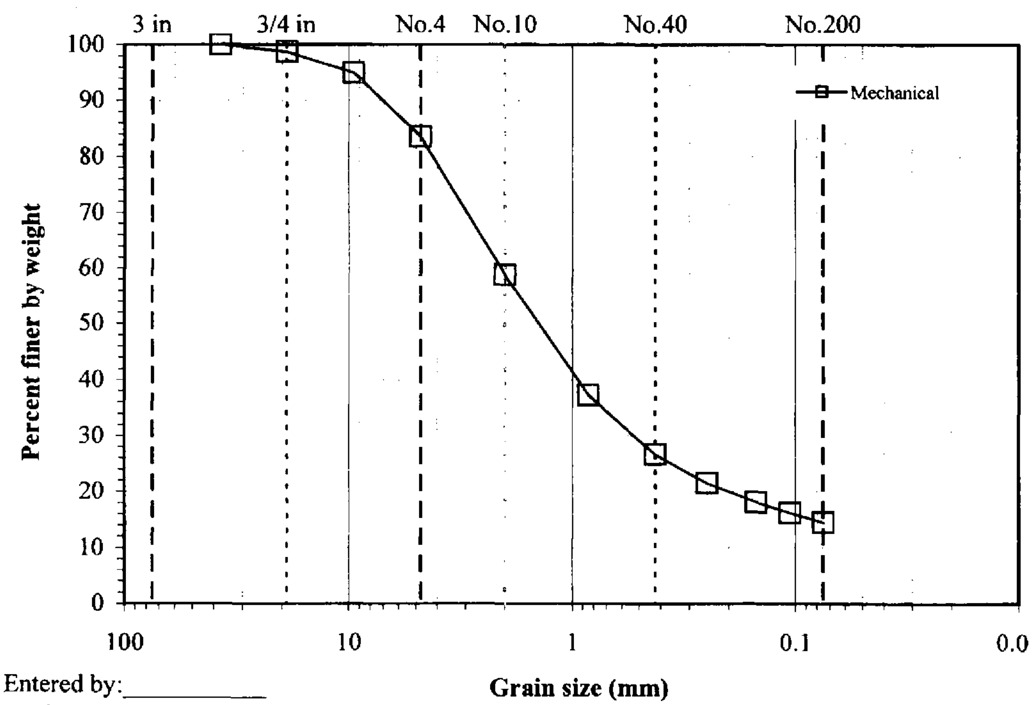
Project: CS Mining Existing Facility Expansion
No: 01640-001 (II)
Location: Milford, UT
Date: 3/19/2013
By: BRR

Boring No.: TP-4
Sample:
Depth: 5-6'
Description: Light brown clayey sand with gravel

Split:	Yes	
Split sieve:	3/8"	
	Moist	Dry
Total sample wt. (g):	24740.03	23683.0
+3/8" Coarse fraction (g):	1200.53	1181.0
-3/8" Split fraction (g):	1333.15	1274.39
Split fraction:	0.950	

Water content data	C.F.(+3/8")	S.F.(-3/8")
Moist soil + tare (g):	1424.10	1643.73
Dry soil + tare (g):	1404.61	1584.97
Tare (g):	223.56	310.58
Water content (%):	1.7	4.6

Sieve	Accum. Wt. Ret. (g)	Grain Size (mm)	Percent Finer	
8"	-	200	-	
6"	-	150	-	
4"	-	100	-	
3"	-	75	-	
1.5"	-	37.5	100.0	
3/4"	310.72	19	98.7	
3/8"	1181.04	9.5	95.0	←Split
No.4	155.30	4.75	83.4	
No.10	486.00	2	58.8	
No.20	774.33	0.85	37.3	
No.40	917.02	0.425	26.6	
No.60	986.29	0.25	21.5	
No.100	1032.02	0.15	18.1	
No.140	1057.20	0.106	16.2	
No.200	1080.10	0.075	14.5	



Gravel (%): 16.6
Sand (%): 68.9
Fines (%): 14.5

Entered by:___________
Reviewed:___________

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Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis

(ASTM D6913)

IGES

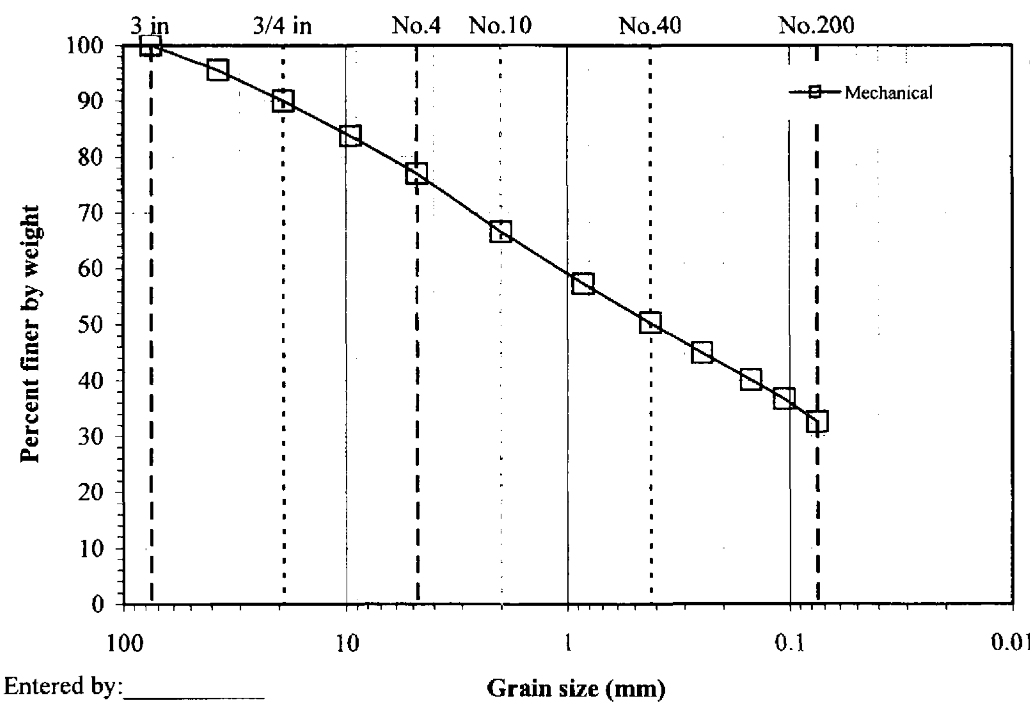
Project: CS Mining Existing Facility Expansion
No: 01640-001 (II)
Location: Milford, UT
Date: 3/19/2013
By: BRR

Boring No.: TP-5
Sample: Combined Samples
Depth: 3-4' & 6'
Description: Brown silty sand with gravel

Split:	Yes	
Split sieve:	3/4"	
	Moist	Dry
Total sample wt. (g):	29937.60	27914.3
+3/4" Coarse fraction (g):	2835.1	2770.24
-3/4" Split fraction (g):	1462.75	1357.05
Split fraction:	0.901	

Water content data	C.F.(+3/4")	S.F.(-3/4")
Moist soil + tare (g):	1162.34	1872.56
Dry soil + tare (g):	1145.97	1766.86
Tare (g):	446.79	409.81
Water content (%):	2.3	7.8

Sieve	Accum. Wt. Ret. (g)	Grain Size (mm)	Percent Finer	
8"	-	200	-	
6"	-	150	-	
4"	-	100	-	
3"	-	75	100.0	
1.5"	1238.99	37.5	95.6	
3/4"	2770.24	19	90.1	←Split
3/8"	96.87	9.5	83.6	
No.4	198.12	4.75	76.9	
No.10	356.19	2	66.4	
No.20	495.76	0.85	57.2	
No.40	598.96	0.425	50.3	
No.60	680.14	0.25	44.9	
No.100	753.83	0.15	40.0	
No.140	804.63	0.106	36.7	
No.200	866.29	0.075	32.6	



Gravel (%): 23.1
Sand (%): 44.4
Fines (%): 32.6

Entered by:___________
Reviewed:___________

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Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis

(ASTM D6913)

IGES

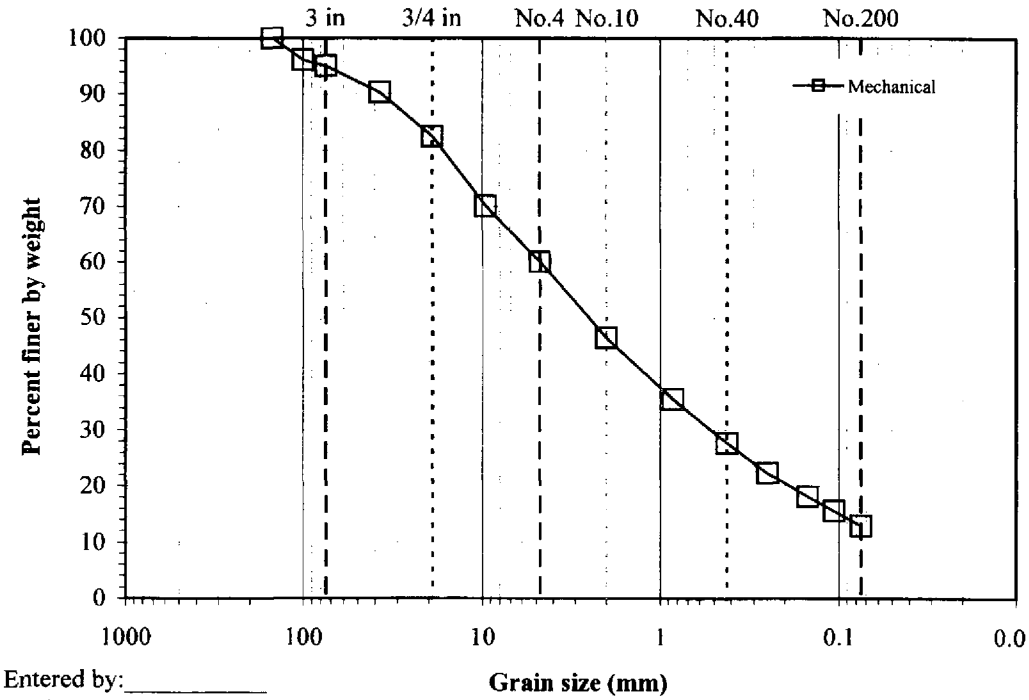
Project: CS Mining Existing Facility Expansion
No: 01640-001 (II)
Location: Milford, UT
Date: 3/12/2013
By: BRR

Boring No.: TP-6
Sample: Combined Samples
Depth: 2-3' & 5-6'
Description: Brown silty sand with gravel

Split:	Yes	
Split sieve:	3/4"	
	Moist	Dry
Total sample wt. (g):	54142.50	51306.5
+3/4" Coarse fraction (g):	9270.1	9041.3
-3/4" Split fraction (g):	1411.32	1329.32
Split fraction:	0.824	

Water content data	C.F.(+3/4")	S.F.(-3/4")
Moist soil + tare (g):	1608.92	1821.81
Dry soil + tare (g):	1579.30	1739.81
Tare (g):	408.93	410.49
Water content (%):	2.5	6.2

Sieve	Accum. Wt. Ret. (g)	Grain Size (mm)	Percent Finer	
8"	-	200	-	
6"	-	150	100.0	
4"	2001.06	100	96.1	
3"	2580.78	75	95.0	
1.5"	5025.03	37.5	90.2	
3/4"	9041.28	19	82.4	←Split
3/8"	200.51	9.5	70.0	
No.4	360.09	4.75	60.1	
No.10	579.84	2	46.4	
No.20	757.12	0.85	35.5	
No.40	882.23	0.425	27.7	
No.60	969.19	0.25	22.3	
No.100	1036.91	0.15	18.1	
No.140	1078.58	0.106	15.5	
No.200	1120.82	0.075	12.9	



Gravel (%): 39.9
Sand (%): 47.1
Fines (%): 12.9

Entered by:__________
Reviewed:__________

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Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis

(ASTM D6913)

IGES

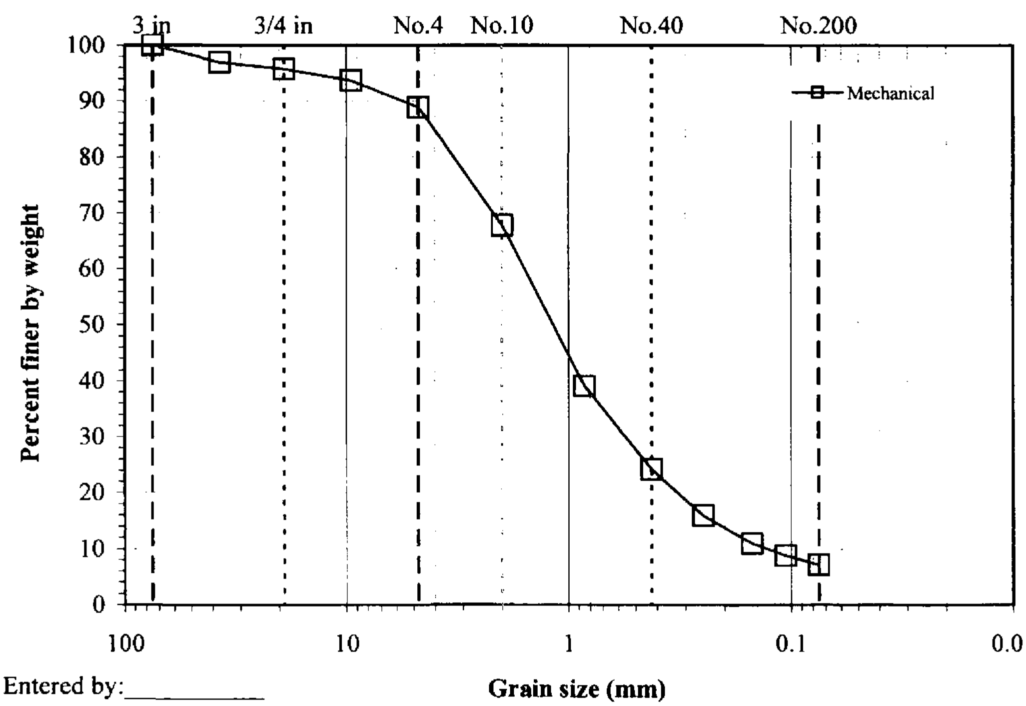
Project: CS Mining Existing Facility Expansion
No: 01640-001 (II)
Location: Milford, UT
Date: 3/19/2013
By: BRR

Boring No.: TP-7
Sample:
Depth: 2-3'
Description: Brown sand with silt

Split:	Yes	
Split sieve:	3/4"	
	Moist	Dry
Total sample wt. (g):	27690.11	26689.7
+3/4" Coarse fraction (g):	1167.91	1148.9
-3/4" Split fraction (g):	1497.66	1442.24
Split fraction:	0.957	

Water content data	C.F.(+3/4")	S.F.(-3/4")
Moist soil + tare (g):	1387.12	1813.48
Dry soil + tare (g):	1368.10	1758.06
Tare (g):	219.18	315.82
Water content (%):	1.7	3.8

Sieve	Accum. Wt. Ret. (g)	Grain Size (mm)	Percent Finer	
8"	-	200	-	
6"	-	150	-	
4"	-	100	-	
3"	-	75	100.0	
1.5"	822.88	37.5	96.9	
3/4"	1148.89	19	95.7	←Split
3/8"	31.41	9.5	93.6	
No.4	102.75	4.75	88.9	
No.10	422.36	2	67.7	
No.20	854.17	0.85	39.0	
No.40	1078.68	0.425	24.1	
No.60	1203.08	0.25	15.9	
No.100	1277.34	0.15	10.9	
No.140	1310.37	0.106	8.7	
No.200	1334.73	0.075	7.1	



Gravel (%): 11.1
Sand (%): 81.7
Fines (%): 7.1

Entered by:__________

Reviewed:__________

Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis

(ASTM D6913)

IGES

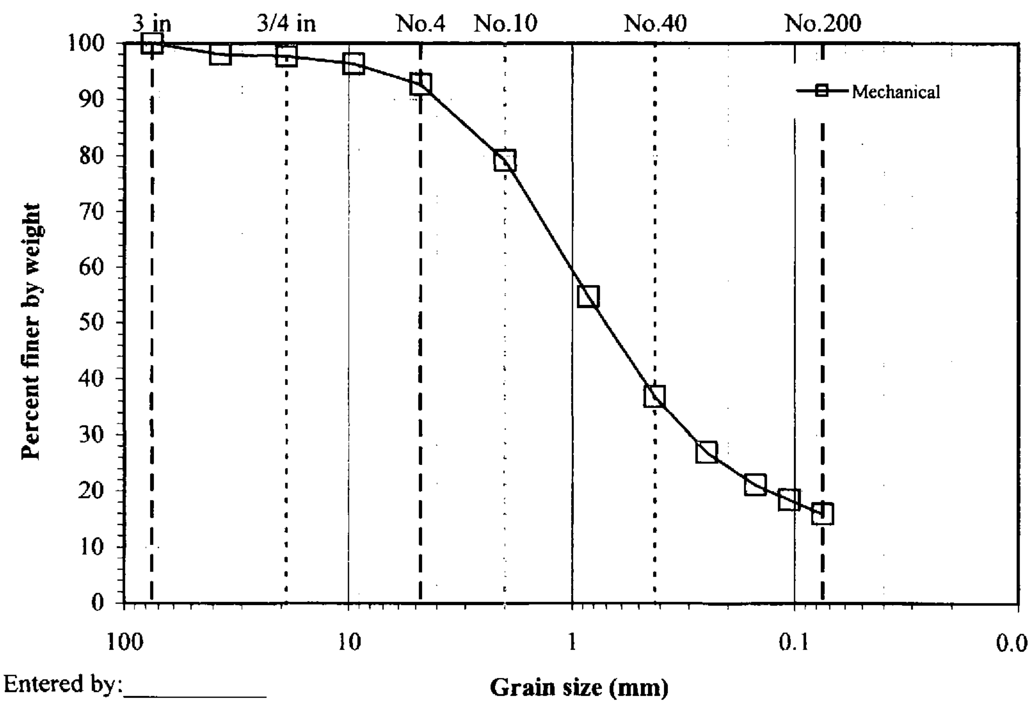
Project: CS Mining Existing Facility Expansion
No: 01640-001 (II)
Location: Milford, UT
Date: 3/19/2013
By: BRR

Boring No.: TP-8
Sample:
Depth: 3-4'
Description: Brown silty sand

Split:	Yes	
Split sieve:	3/8"	
	Moist	Dry
Total sample wt. (g):	25314.71	24389.2
+3/8" Coarse fraction (g):	914.6	904.1
-3/8" Split fraction (g):	1417.82	1364.65
Split fraction:	0.963	

Water content data	C.F.(+3/8")	S.F.(-3/8")
Moist soil + tare (g):	1144.10	1826.72
Dry soil + tare (g):	1133.50	1773.55
Tare (g):	221.95	408.90
Water content (%):	1.2	3.9

Sieve	Accum. Wt. Ret. (g)	Grain Size (mm)	Percent Finer	
8"	-	200	-	
6"	-	150	-	
4"	-	100	-	
3"	-	75	100.0	
1.5"	483.63	37.5	98.0	
3/4"	585.78	19	97.6	
3/8"	904.09	9.5	96.3	←Split
No.4	51.72	4.75	92.6	
No.10	243.89	2	79.1	
No.20	589.92	0.85	54.7	
No.40	843.07	0.425	36.8	
No.60	983.22	0.25	26.9	
No.100	1065.02	0.15	21.1	
No.140	1103.94	0.106	18.4	
No.200	1140.13	0.075	15.8	



Gravel (%): 7.4
Sand (%): 76.8
Fines (%): 15.8

Entered by:__________
Reviewed:__________

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Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis

(ASTM D6913)

IGES

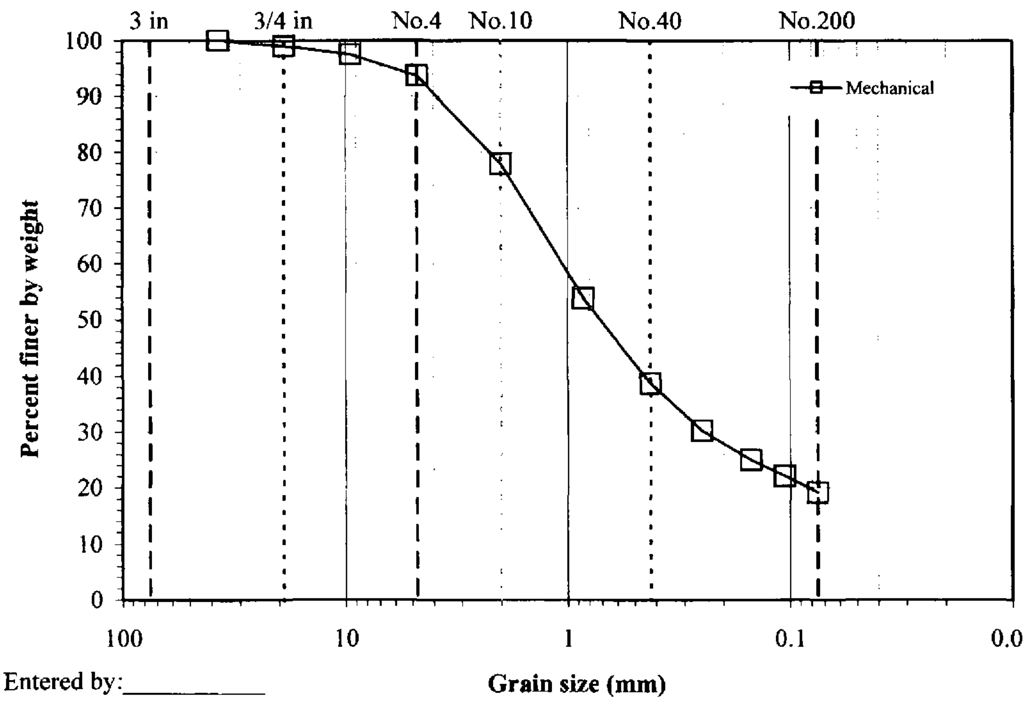
Project: CS Mining Existing Facility Expansion
No: 01640-001 (II)
Location: Milford, UT
Date: 3/19/2013
By: BRR

Boring No.: TP-9
Sample:
Depth: 3-4'
Description: Brown silty sand

Split:	Yes	
Split sieve:	3/8"	
	Moist	Dry
Total sample wt. (g):	23782.06	22671.6
+3/8" Coarse fraction (g):	573.16	564.2
-3/8" Split fraction (g):	1068.84	1018.11
Split fraction:	0.975	

Water content data	C.F.(+3/8")	S.F.(-3/8")
Moist soil + tare (g):	701.07	1477.80
Dry soil + tare (g):	692.15	1427.07
Tare (g):	127.89	408.96
Water content (%):	1.6	5.0

Sieve	Accum. Wt. Ret. (g)	Grain Size (mm)	Percent Finer	
8"	-	200	-	
6"	-	150	-	
4"	-	100	-	
3"	-	75	-	
1.5"	-	37.5	100.0	
3/4"	217.12	19	99.0	
3/8"	564.24	9.5	97.5	←Split
No.4	40.49	4.75	93.6	
No.10	204.90	2	77.9	
No.20	456.22	0.85	53.8	
No.40	614.42	0.425	38.7	
No.60	701.93	0.25	30.3	
No.100	757.61	0.15	24.9	
No.140	787.21	0.106	22.1	
No.200	817.63	0.075	19.2	



Gravel (%): 6.4
Sand (%): 74.4
Fines (%): 19.2

Entered by:__________
Reviewed:__________

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Particle-Size Analysis of Soils *with hydrometer*

(ASTM D422)

IGES

Project: CS Mining Existing Facility Expansion
No: 01640-001 (II)
Location: Milford, UT
Date: 3/19/2013
By: BRR

Boring No.: Tailings Beach
Sample: 1
Depth: Surface
Description: Grey silty sand

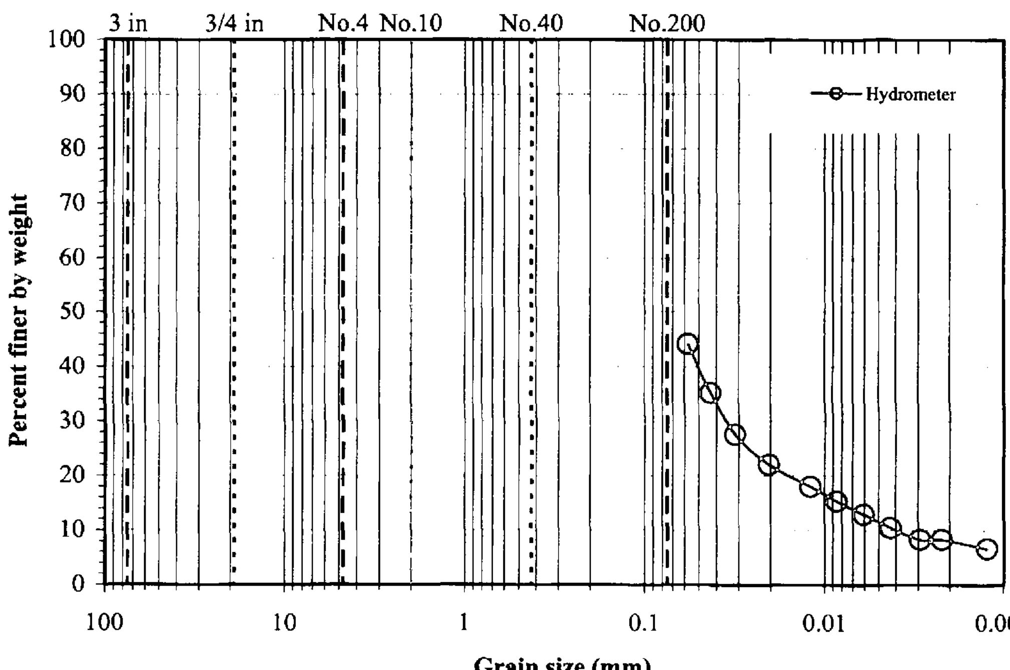
Split sieve:	No	
	Moist	Dry
Total sample wt. (g):	66.9	66.37
		0.00
		0.00
Hydrometer fraction (g):	66.90	66.37
	1.000	

Water content data	C.F.(+)	S.F.(-)	Hyd.(-No.10)
Moist soil + tare (g):	-	66.23	66.23
Dry soil + tare (g):	-	65.88	65.88
Tare (g):	-	21.93	21.93
Water content (%):	0.00	0.80	0.80

Hydrometer data				
Hyd. split:	No.10		Slope:	-0.1641
			Intercept:	16.3
Gs:	3.134	Determined	α:	0.91
Bulb No.	2		Hyd. fraction:	100.00
Dispersion period (min):	15		Dispersion device:	Air-jet

Sieve	Accum. Wt. Ret. (g)	Grain Size (mm)	Percent Finer
8"	-	200	-
6"	-	150	-
4"	-	100	-
3"	-	75	-
1.5"	-	37.5	-
3/4"	-	19	-
3/8"	-	9.5	-
No.4	-	4.75	-
No.10	-	2	-
No.20	-	0.85	-
No.40	-	0.425	-
No.60	-	0.25	-
No.100	-	0.15	-
No.140	-	0.106	-
No.200	-	0.075	-

Elapsed time (min)	Temp. (°C)	Hydrometer Reading	Grain Size (mm)	% Soil in Suspension
0.5	14.8	38	0.05747	44.08
1	14.8	31.5	0.04274	35.13
2	14.8	26	0.03142	27.55
5	14.8	22	0.02041	22.04
15	15	19	0.01198	17.98
30	15.4	17	0.00853	15.36
60	16.3	15	0.00604	12.92
120	17.1	13	0.00428	10.45
250	18.9	11	0.00293	8.32
420	20.8	10.5	0.00221	8.30
1440	18.2	10	0.00124	6.70



Entered by:__________
Reviewed:__________

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Particle-Size Analysis of Soils *with hydrometer*
(ASTM D422)

IGES

Project: **CS Mining Existing Facility Expansion**
No: **01640-001 (II)**
Location: Milford, UT
Date: 3/19/2013
By: BRR

Boring No.: **Tailings Beach**
Sample: **3**
Depth: **Surface**
Description: Grey silty sand

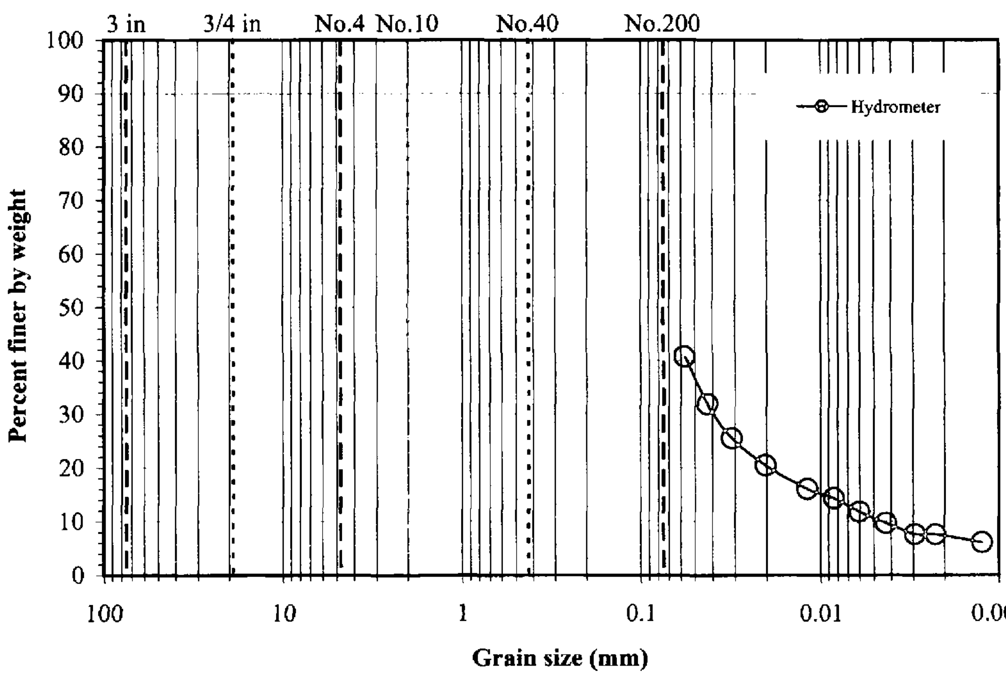
Split sieve:	No	
	Moist	Dry
Total sample wt. (g):	73.33	72.37
		0.00
		0.00
Hydrometer fraction (g):	73.33	72.37
	1.000	

Water content data	C.F.(+)	S.F.(-)	Hyd.(-No.10)
Moist soil + tare (g):	-	58.09	58.09
Dry soil + tare (g):	-	57.61	57.61
Tare (g):	-	21.55	21.55
Water content (%):	0.00	1.33	1.33

Hydrometer data				
Hyd. split:	No.10		Slope:	-0.1641
			Intercept:	16.3
Gs:	3.134	Determined	α:	0.91
Bulb No.	2		Hyd. fraction:	100.00
Dispersion period (min):	15		Dispersion device:	Air-jet

Sieve	Accum. Wt. Ret. (g)	Grain Size (mm)	Percent Finer
8"	-	200	-
6"	-	150	-
4"	-	100	-
3"	-	75	-
1.5"	-	37.5	-
3/4"	-	19	-
3/8"	-	9.5	-
No.4	-	4.75	-
No.10	-	2	-
No.20	-	0.85	-
No.40	-	0.425	-
No.60	-	0.25	-
No.100	-	0.15	-
No.140	-	0.106	-
No.200	-	0.075	-

Elapsed time (min)	Temp. (°C)	Hydrometer Reading	Grain Size (mm)	% Soil in Suspension
0.5	15.6	38	0.05689	40.69
1	15.6	31	0.04246	31.84
2	15.6	26	0.03111	25.52
5	15.6	22	0.02020	20.47
15	15.9	18.5	0.01188	16.14
30	16.4	17	0.00843	14.41
60	16.5	15	0.00602	11.91
120	17.5	13	0.00425	9.71
250	19	11	0.00293	7.66
411	20.7	10.5	0.00224	7.5[illegible]
1440	18.2	10	0.00124	6.14



Entered by:__________
Reviewed:__________

Particle-Size Analysis of Soils *with hydrometer*

(ASTM D422)

IGES

Project: CS Mining Existing Facility Expansion
No: 01640-001 (II)
Location: Milford, UT
Date: 3/25/2013
By: BRR

Boring No.: Tailings Beach
Sample: 5
Depth: Surface
Description: Grey silty sand

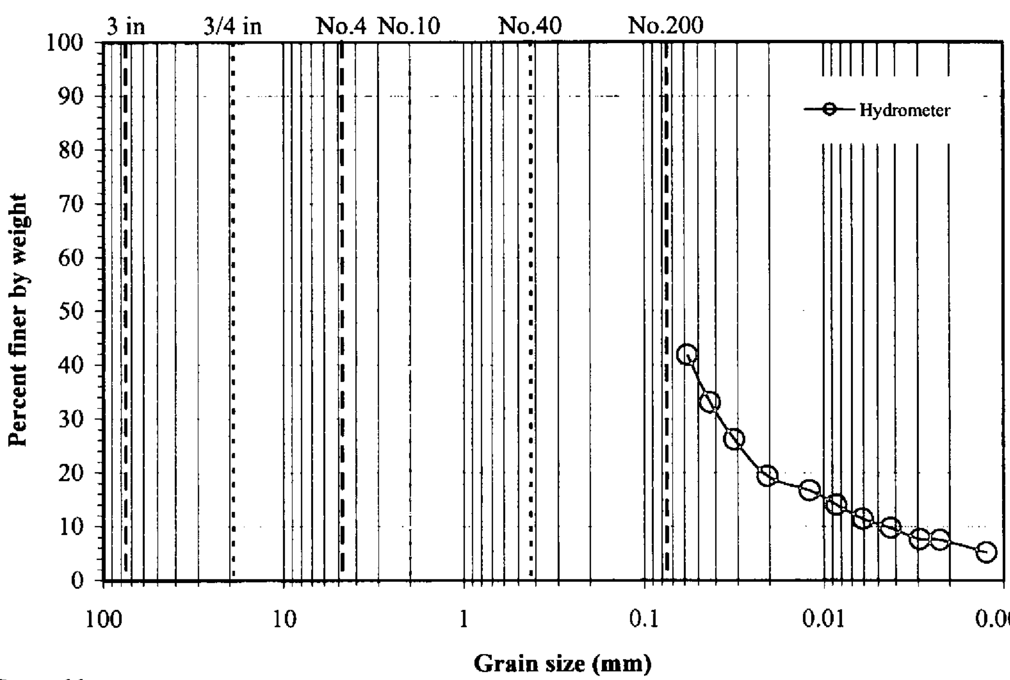
Split sieve:	No	
	Moist	Dry
Total sample wt. (g):	67.55	67.09
		0.00
		0.00
Hydrometer fraction (g):	67.55	67.09
	1.000	

Water content data	C.F.(+)	S.F.(-)	Hyd.(-No.10)
Moist soil + tare (g):	-	55.79	55.79
Dry soil + tare (g):	-	55.56	55.56
Tare (g):	-	21.72	21.72
Water content (%):	0.00	0.68	0.68

Hydrometer data				
Hyd. split:	No.10		Slope:	-0.1641
Gs:	3.134	Determined	Intercept:	16.3
Bulb No.	2		α:	0.91
Dispersion period (min):	15		Hyd. fraction:	100.00
			Dispersion device:	Air-jet

Sieve	Accum. Wt. Ret. (g)	Grain Size (mm)	Percent Finer
8"	-	200	-
6"	-	150	-
4"	-	100	-
3"	-	75	-
1.5"	-	37.5	-
3/4"	-	19	-
3/8"	-	9.5	-
No.4	-	4.75	-
No.10	-	2	-
No.20	-	0.85	-
No.40	-	0.425	-
No.60	-	0.25	-
No.100	-	0.15	-
No.140	-	0.106	-
No.200	-	0.075	-

Elapsed time (min)	Temp. (°C)	Hydrometer Reading	Grain Size (mm)	% Soil in Suspension
0.5	15.5	36.5	0.05766	41.81
1	15.5	30	0.04283	32.95
2	15.5	25	0.03136	26.13
5	15.5	20	0.02049	19.32
15	15.6	18	0.01196	16.63
30	15.9	16	0.00853	14.01
60	16.4	14	0.00607	11.45
120	17.4	12.5	0.00427	9.76
250	19.1	10.5	0.00293	7.62
403	20.8	10	0.00227	7.53
1440	18.2	9	0.00125	5.26



Entered by:__________

Reviewed:__________

Particle-Size Analysis of Soils *with hydrometer*

(ASTM D422)

IGES

Project: CS Mining Existing Facility Expansion
No: 01640-001 (II)
Location: Milford, UT
Date: 3/19/2013
By: BRR

Boring No.: Tailings Beach
Sample: 7
Depth: Surface
Description: Grey silty sand

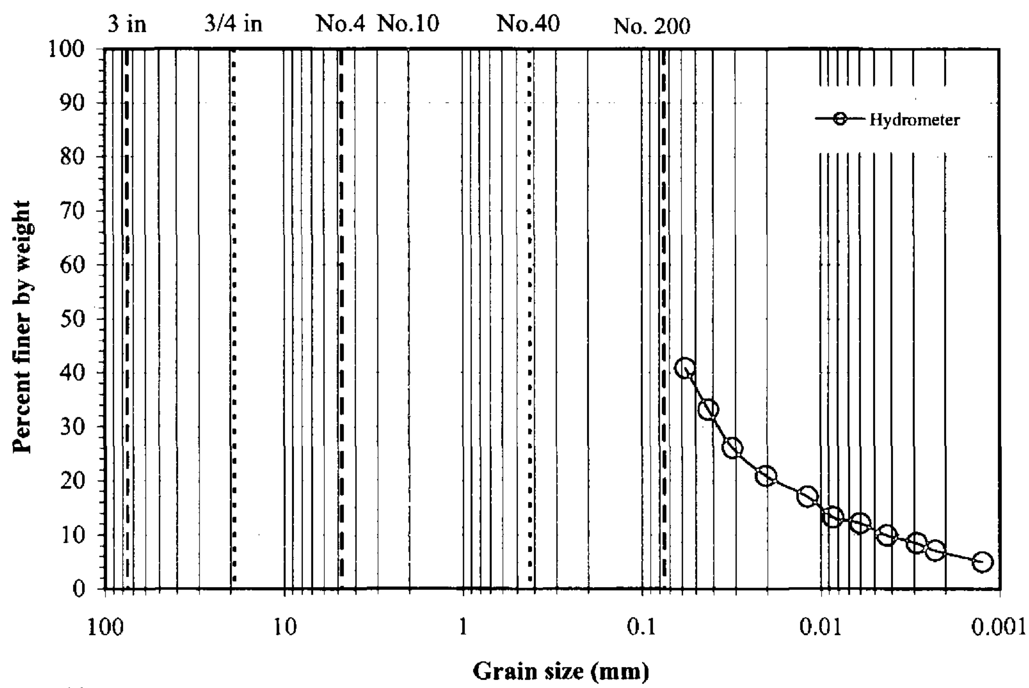
Split sieve:	No	
	Moist	Dry
Total sample wt. (g):	71.3	70.81
		0.00
		0.00
Hydrometer fraction (g):	71.30	70.81
	1.000	

Water content data	C.F.(+)	S.F.(-)	Hyd.(-No.10)
Moist soil + tare (g):	-	56.65	56.65
Dry soil + tare (g):	-	56.41	56.41
Tare (g):	-	21.84	21.84
Water content (%):	0.00	0.69	0.69

Hydrometer data				
			Slope:	-0.1641
Hyd. split:	No.10		Intercept:	16.3
Gs:	3.134	Determined	α:	0.91
Bulb No.	2		Hyd. fraction:	100.00
Dispersion period (min):	15		Dispersion device:	Air-jet

Sieve	Accum. Wt. Ret. (g)	Grain Size (mm)	Percent Finer
8"	-	200	-
6"	-	150	-
4"	-	100	-
3"	-	75	-
1.5"	-	37.5	-
3/4"	-	19	-
3/8"	-	9.5	-
No.4	-	4.75	-
No.10	-	2	-
No.20	-	0.85	-
No.40	-	0.425	-
No.60	-	0.25	-
No.100	-	0.15	-
No.140	-	0.106	-
No.200	-	0.075	-

Elapsed time (min)	Temp. (°C)	Hydrometer Reading	Grain Size (mm)	% Soil in Suspension
0.5	15.4	37.5	0.05728	40.87
1	15.4	31.5	0.04242	33.12
2	15.4	26	0.03119	26.02
5	15.4	22	0.02026	20.86
15	15.5	19	0.01190	17.01
30	15.7	16	0.00855	13.21
60	16.3	15	0.00604	12.11
120	17.5	13	0.00425	9.92
250	19.1	11.5	0.00291	8.51
397	20.7	10	0.00229	7.10
1440	18.1	9	0.00125	4.95



Entered by:__________

Reviewed:__________

Specific Gravity of Soil Solids by Water Pycnometer

(ASTM D854)

IGES

Project: CS Mining Existing Facility Expansion
No: 01640-001 (II)
Location: Milford, UT
Date: 3/21/2013
By: JDF

Drill hole / Sample:	Tailings Beach					
Sample No:	Bucket					
Depth (ft)	Surface					
Engineering Classification	Not req.					
Method	A					
Material passing No. 4 seive, P (%)	100					
Pycnometer No.	3					
Mass of pycnometer (g)	170.57					
Mass of pycnometer, soil, and water, $M_{\rho ws,t}$ (g)	704.54					
Temperature, T_t (°C)	19.0					
Mass of pycnometer and water at test temperature, $M_{pw,t}$ (g)	669.47					
Mass of tare + dry soil (g)	498.27					
Mass of tare (g)	446.76					
Mass of soil, M_s (g)	51.51					
Specific gravity of soil solids at test temperature, G_t	3.133					
Temperature coefficient, K	1.00020					
Specific gravity of soil solids at 20°C, $G_{20°C}$	3.134					
Apparent specific gravity of solids retained on No. 4, $G_{1@20°C}$						
Average specific gravity at 20°C, $G_{avg\ @20°C}$						

Tested by:___________

Reviewed by:___________

Laboratory Compaction Characteristics of Soil

(ASTM D698 / D1557)

IGES

Project: CS Mining Existing Facility Expansion
No: 01640-001 (II)
Location: Milford, UT
Date: 3/13/2013
By: BRR

Boring No.: TP-3
Sample: Combined Samples
Depth: 1-3'
Sample Description: Brown silty sand with gravel
Engineering Classification: Not requested
As-received water content (%): Not requested

Method: ASTM D698 C
Mold Id. Inc 7
Mold volume (ft^3): 0.0752

Preparation method: Moist
Rammer: Mechanical-sector face
Rock Correction: Yes * See results below
Percent fraction retained, Pc (%) 21.2
Percent fraction passing, Pf (%) 78.8

Optimum water content (%): 10.3
Maximum dry unit weight (pcf): 127.5

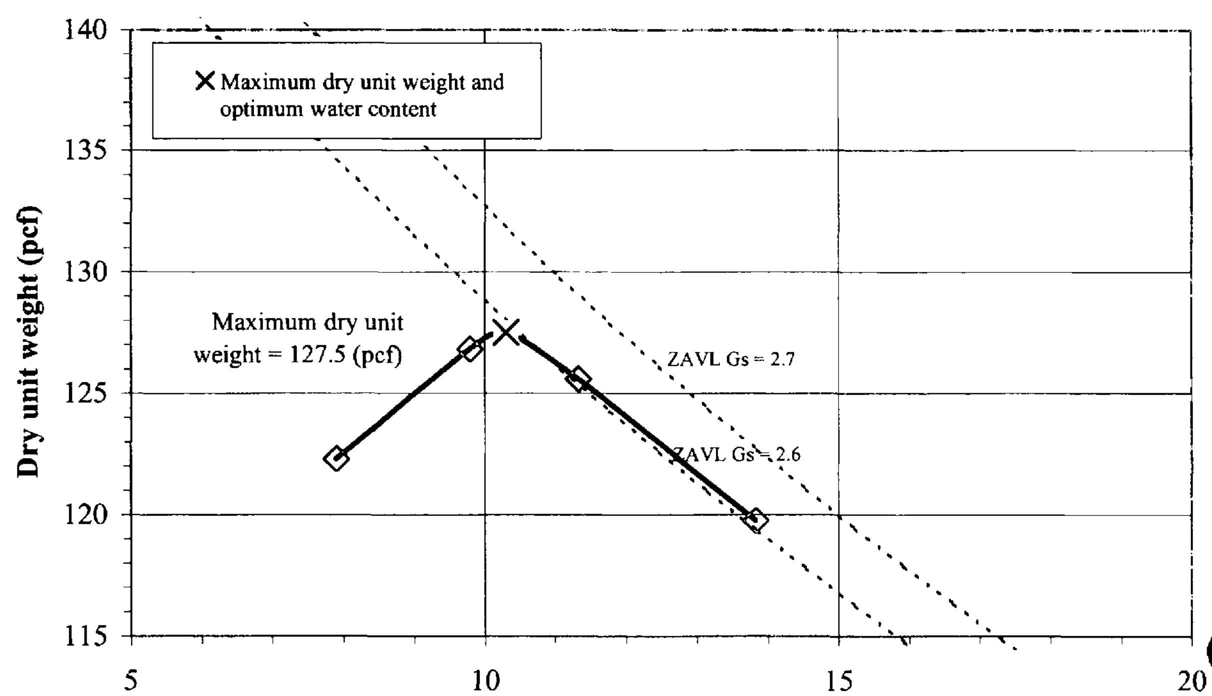
Point Number	+2%	+4%	+6%	+8%				
Wt. Sample + Mold (g)	11036.5	11283.9	11304.1	11184.7				
Wt. of Mold (g)	6537.5	6537.5	6537.5	6537.5				
Wet Unit Wt., γ_m (pcf)	132.0	139.2	139.8	136.3				
Wet Soil + Tare (g)	1497.90	1501.86	1439.76	1431.35				
Dry Soil + Tare (g)	1422.13	1409.40	1338.74	1314.21				
Tare (g)	462.95	464.17	446.58	467.02				
Water Content, w (%)	**7.9**	**9.8**	**11.3**	**13.8**				
Dry Unit Wt., γ_d (pcf)	**122.3**	**126.8**	**125.6**	**119.8**				

*Correction of Unit Weight and Water Content for Soils Containing Oversize Particles

(ASTM D4718)

Corrected water content (%): 8.4
Corrected dry unit weight (pcf): 134.0

Oversized fraction, +3/4-in. (%): 21.2
Water content, +3/4-in. (%): 1.6
Sieve for oversized fraction: 3/4-in.
Bulk specific gravity, Gs: 2.65 Assumed



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Laboratory Compaction Characteristics of Soil

(ASTM D698 / D1557)

IGES

Project: CS Mining Existing Facility Expansion
No: 01640-001 (II)
Location: Milford, UT
Date: 3/14/2013
By: BRR

Boring No.: TP-4
Sample:
Depth: 5-6'
Sample Description: Light brown clayey sand with gravel
Engineering Classification: Not requested
As-received water content (%): Not requested

Method: ASTM D698 B
Mold Id. Inc 3
Mold volume (ft^3): 0.0332

Preparation method: Moist
Rammer: Mechanical-circular face
Rock Correction: Yes * See results below
Percent fraction retained, Pc (%) 5.0
Percent fraction passing, Pf (%) 95.0

Optimum water content (%): 13.6
Maximum dry unit weight (pcf): 120.7

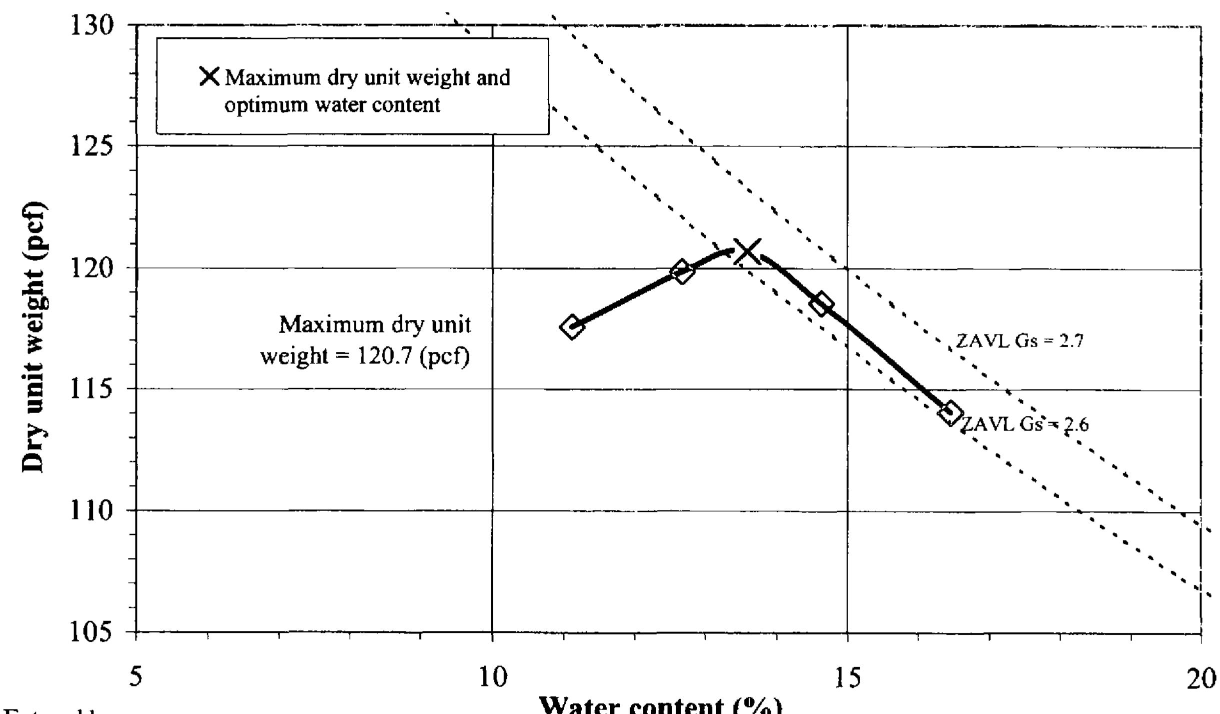
Point Number	+6%	+8%	+10%	12%				
Wt. Sample + Mold (g)	6142.0	6208.0	6221.0	6175.0				
Wt. of Mold (g)	4172.7	4172.7	4172.7	4172.7				
Wet Unit Wt., γ_m (pcf)	130.7	135.0	135.9	132.9				
Wet Soil + Tare (g)	776.60	818.73	849.93	786.20				
Dry Soil + Tare (g)	713.04	741.04	757.80	692.40				
Tare (g)	141.35	128.10	128.25	122.74				
Water Content, w (%)	**11.1**	12.7	**14.6**	16.5				
Dry Unit Wt., γ_d (pcf)	**117.6**	119.9	**118.6**	114.1				

***Correction of Unit Weight and Water Content for Soils Containing Oversize Particles**

(ASTM D4718)

Corrected water content (%): 13.0
Corrected dry unit weight (pcf): 122.4

Oversized fraction, +3/8-in. (%): 5.0
Water content, +3/8-in. (%): 1.7
Sieve for oversized fraction: 3/8-in.
Bulk specific gravity, Gs: 2.65 Assumed



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Laboratory Compaction Characteristics of Soil

(ASTM D698 / D1557)

IGES

Project: CS Mining Existing Facility Expansion
No: 01640-001 (II)
Location: Milford, UT
Date: 3/14/2013
By: BRR

Boring No.: TP-5
Sample: Combined Samples
Depth: 3-4' & 6'
Sample Description: Brown silty sand with gravel
Engineering Classification: Not requested
As-received water content (%): Not requested

Method: ASTM D698 C
Mold Id. Inc 4
Mold volume (ft^3): 0.0751

Preparation method: Moist
Rammer: Mechanical-sector face
Rock Correction: Yes * See results below
Percent fraction retained, Pc (%) 9.9
Percent fraction passing, Pf (%) 90.1

Optimum water content (%): 13.2
Maximum dry unit weight (pcf): 115.7

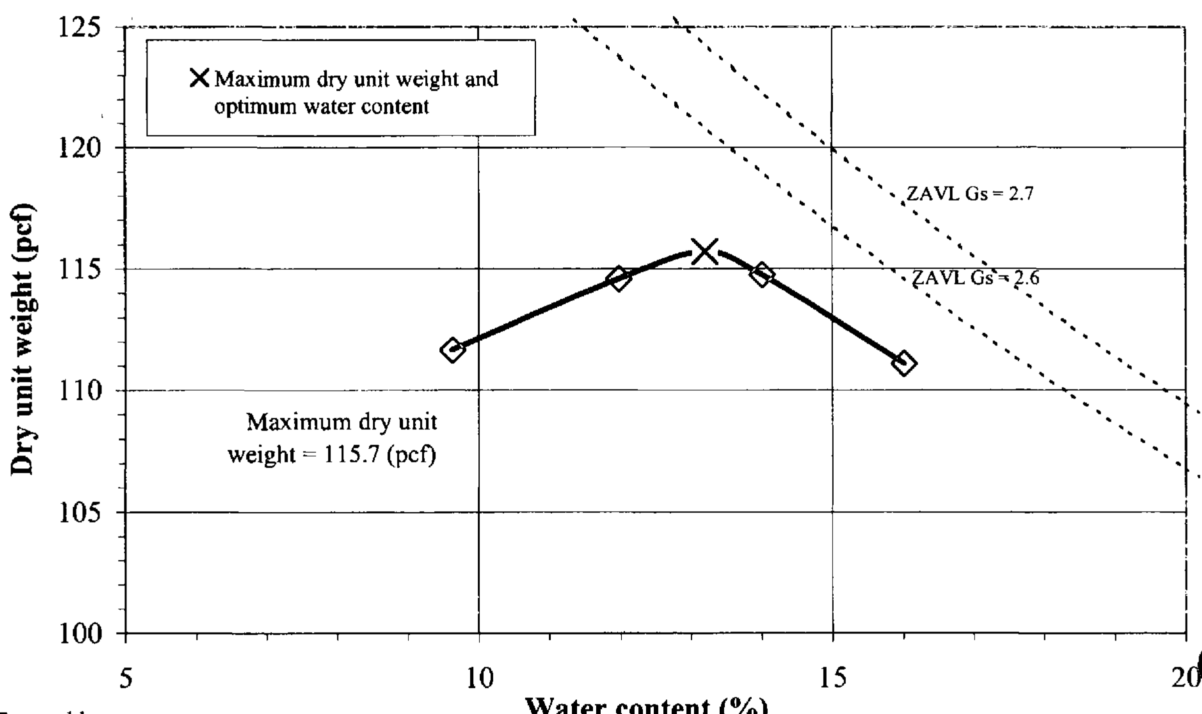
Point Number	+4%	+6%	+8%	+2%				
Wt. Sample + Mold (g)	9974.8	10060.5	9994.8	9774.5				
Wt. of Mold (g)	5603.6	5603.6	5603.6	5603.6				
Wet Unit Wt., γ_m (pcf)	128.3	130.8	128.9	122.4				
Wet Soil + Tare (g)	1366.32	1396.01	1684.65	1302.86				
Dry Soil + Tare (g)	1263.82	1263.24	1516.30	1229.55				
Tare (g)	408.01	315.59	465.15	468.01				
Water Content, w (%)	**12.0**	14.0	**16.0**	9.6				
Dry Unit Wt., γ_d (pcf)	**114.6**	114.7	**111.1**	111.7				

***Correction of Unit Weight and Water Content for Soils Containing Oversize Particles**

(ASTM D4718)

Corrected water content (%): 12.1
Corrected dry unit weight (pcf): 119.2

Oversized fraction, +3/4-in. (%): 9.9
Water content, +3/4-in. (%): 2.3
Sieve for oversized fraction: 3/4-in.
Bulk specific gravity, Gs: 2.65 Assumed



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Laboratory Compaction Characteristics of Soil

(ASTM D698 / D1557)

IGES

Project: CS Mining Existing Facility Expansion
No: 01640-001 (II)
Location: Milford, UT
Date: 3/13/2013
By: BRR

Boring No.: TP-6
Sample: Combined Samples
Depth: 2-3' & 5-6'
Sample Description: Brown silty sand with gravel
Engineering Classification: Not requested
As-received water content (%): Not requested

Method: ASTM D698 C
Mold Id. Inc 4
Mold volume (ft^3): 0.0751

Preparation method: Moist
Rammer: Mechanical-sector face
Rock Correction: Yes * See results below
Percent fraction retained, Pc (%) 17.6
Percent fraction passing, Pf (%) 82.4

Optimum water content (%): 14.5
Maximum dry unit weight (pcf): 115.5

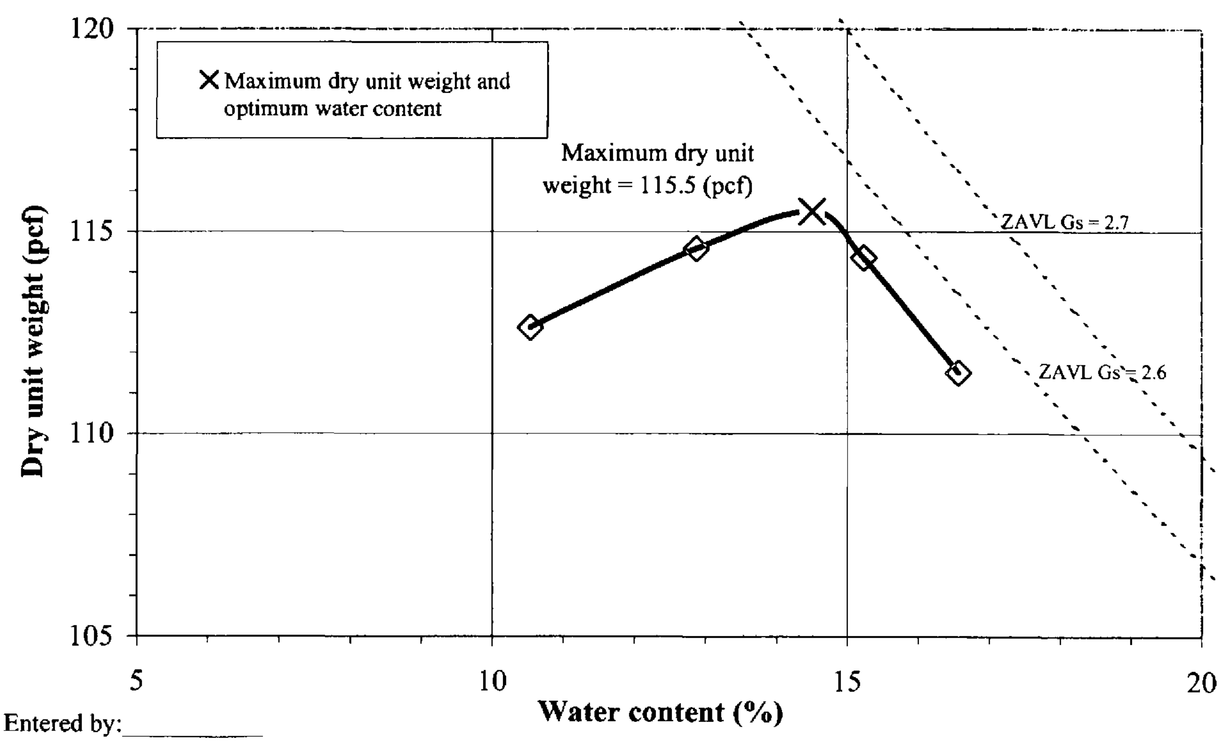
Point Number	+4%	+6%	+8%	+10%				
Wt. Sample + Mold (g)	9845.5	10009.5	10093.2	10032.2				
Wt. of Mold (g)	5603.7	5603.7	5603.7	5603.7				
Wet Unit Wt., γ_m (pcf)	124.5	129.3	131.8	130.0				
Wet Soil + Tare (g)	1254.57	1281.81	1467.16	1315.03				
Dry Soil + Tare (g)	1164.52	1171.07	1325.15	1172.12				
Tare (g)	309.79	310.45	393.09	309.56				
Water Content, w (%)	**10.5**	**12.9**	**15.2**	**16.6**				
Dry Unit Wt., γ_d (pcf)	**112.6**	**114.6**	**114.4**	**111.5**				

***Correction of Unit Weight and Water Content for Soils Containing Oversize Particles**

(ASTM D4718)

Corrected water content (%): 12.4
Corrected dry unit weight (pcf): 122.0

Oversized fraction, +3/4-in. (%): 17.6
Water content, +3/4-in. (%): 2.5
Sieve for oversized fraction: 3/4-in.
Bulk specific gravity, Gs: 2.65 Assumed



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Laboratory Compaction Characteristics of Soil

(ASTM D698 / D1557)

Project: **CS Mining Existing Facility Expansion**
No: **01640-001 (II)**
Location: Milford, UT
Date: 3/14/2013
By: BRR

Boring No.: TP-7
Sample:
Depth: **2-3'**
Sample Description: Brown sand with silt
Engineering Classification: Not requested
As-received water content (%): Not requested

Method: ASTM D698 B
Mold Id. Inc 2
Mold volume (ft^3): 0.0332

Preparation method: Moist
Rammer: Mechanical-circular face
Rock Correction: Yes * See results below
Percent fraction retained, Pc (%) 5.4
Percent fraction passing, Pf (%) 94.6

Optimum water content (%): 12.8
Maximum dry unit weight (pcf): 118.3

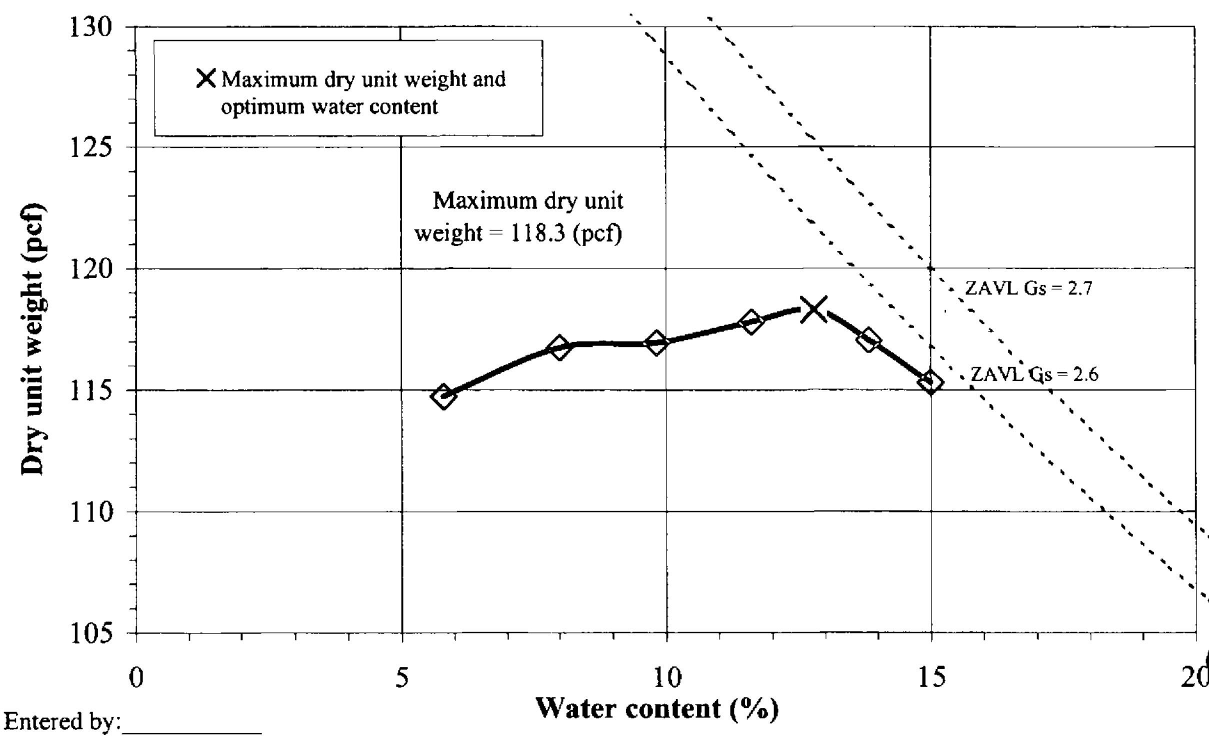
Point Number	+4%	+6%	+2%	+8%	+10%	+12%		
Wt. Sample + Mold (g)	6062.8	6098.2	5992.0	6144.3	6170.8	6161.2		
Wt. of Mold (g)	4163	4163	4163	4163	4163	4163		
Wet Unit Wt., γ_m (pcf)	126.1	128.4	121.4	131.5	133.2	132.6		
Wet Soil + Tare (g)	777.61	707.66	718.70	808.25	842.04	617.74		
Dry Soil + Tare (g)	729.36	655.45	686.13	737.36	755.10	553.87		
Tare (g)	126.14	123.99	123.46	127.14	127.00	127.76		
Water Content, w (%)	**8.0**	**9.8**	**5.8**	**11.6**	**13.8**	**15.0**		
Dry Unit Wt., γ_d (pcf)	**116.7**	**116.9**	**114.7**	**117.8**	**117.0**	**115.3**		

***Correction of Unit Weight and Water Content for Soils Containing Oversize Particles**

(ASTM D4718)

Corrected water content (%): 12.2
Corrected dry unit weight (pcf): 120.1

Oversized fraction, +3/8-in. (%): 5.4
Water content, +3/8-in. (%): 1.7
Sieve for oversized fraction: 3/8-in.
Bulk specific gravity, Gs: 2.65 Assumed



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Laboratory Compaction Characteristics of Soil

(ASTM D698 / D1557)

IGES

Project: CS Mining Existing Facility Expansion
No: 01640-001 (II)
Location: Milford, UT
Date: 3/14/2013
By: BRR

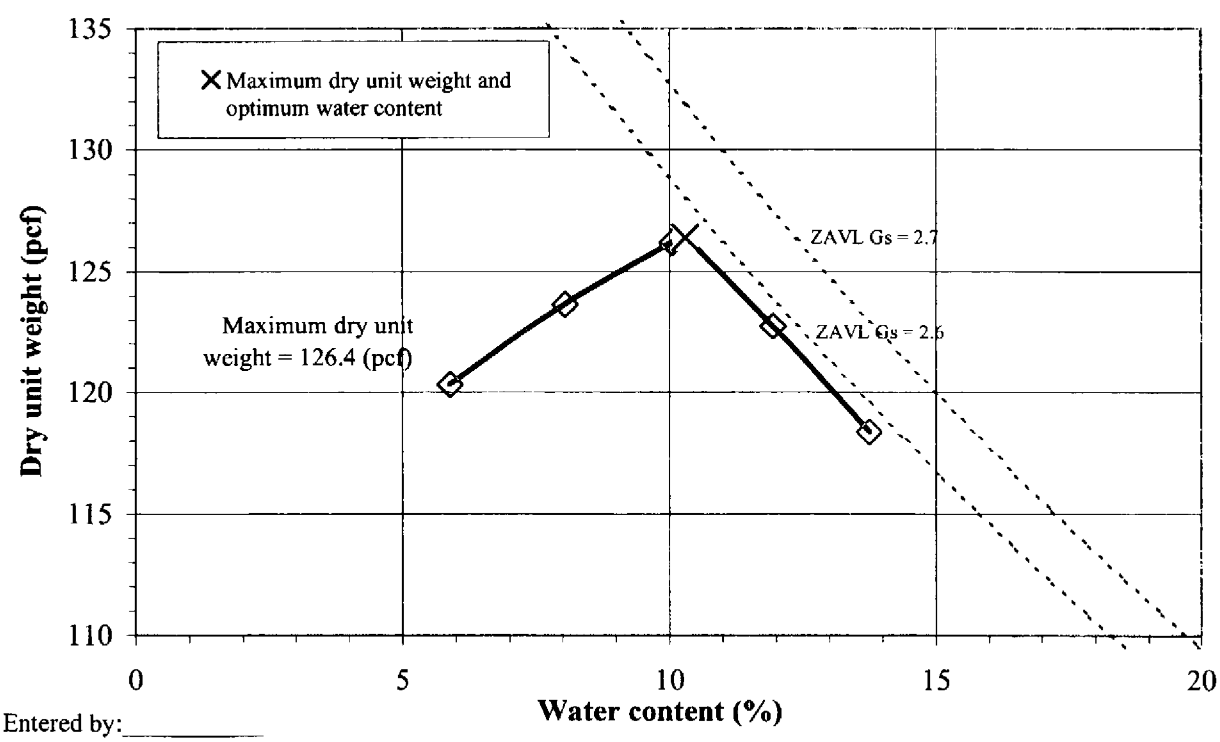
Boring No.: TP-8
Sample:
Depth: 3-4'
Sample Description: Brown silty sand
Engineering Classification: Not requested
As-received water content (%): Not requested

Method: ASTM D698 B
Mold Id. Inc 1
Mold volume (ft^3): 0.0333

Preparation method: Moist
Rammer: Mechanical-circular face
Rock Correction: No

Optimum water content (%): 10.3
Maximum dry unit weight (pcf): 126.4

Point Number	+4%	+6%	+8%	+2%	+10%			
Wt. Sample + Mold (g)	6265.9	6345.6	6323.1	6172.5	6281.8			
Wt. of Mold (g)	4248.2	4248.2	4248.2	4248.2	4248.2			
Wet Unit Wt., γ_m (pcf)	133.6	138.9	137.4	127.4	134.7			
Wet Soil + Tare (g)	787.32	752.37	774.06	712.33	679.61			
Dry Soil + Tare (g)	738.15	695.40	706.39	679.83	612.83			
Tare (g)	126.70	128.46	139.72	127.59	127.35			
Water Content, w (%)	**8.0**	10.0	**11.9**	5.9	13.8			
Dry Unit Wt., γ_d (pcf)	**123.7**	126.2	**122.7**	120.3	118.4			



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Laboratory Compaction Characteristics of Soil

(ASTM D698 / D1557)

IGES

Project: **CS Mining Existing Facility Expansion**
No: **01640-001 (II)**
Location: Milford, UT
Date: 3/14/2013
By: BRR

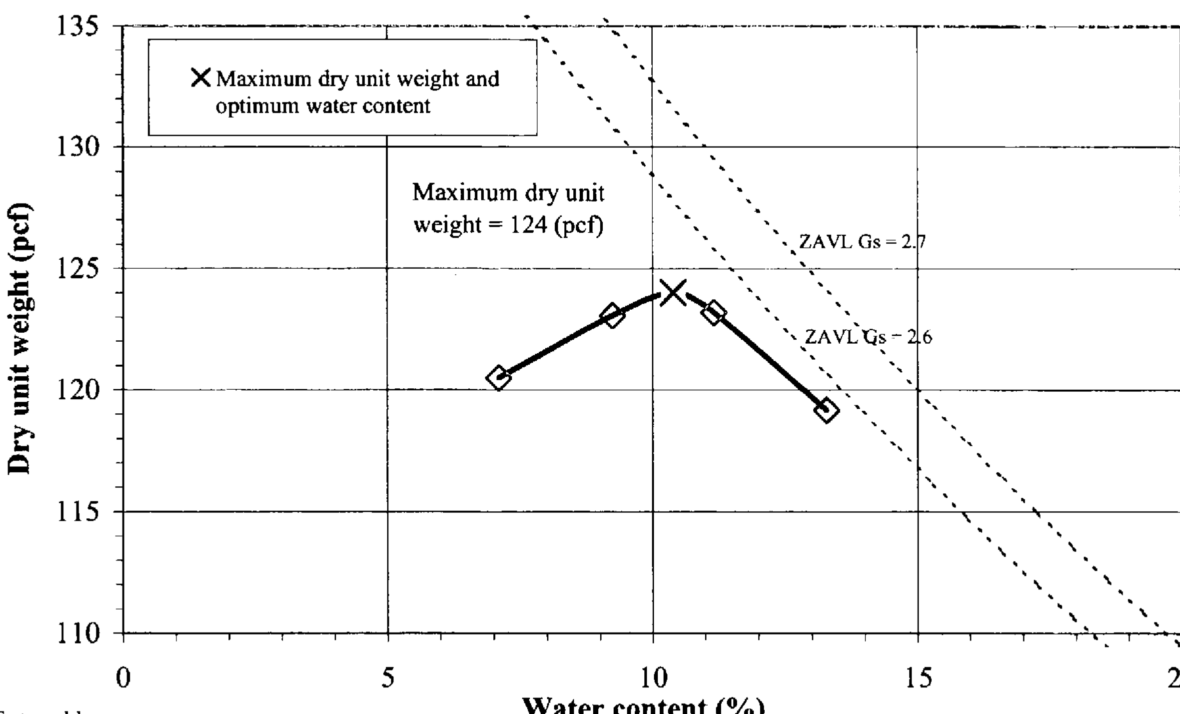
Boring No.: **TP-9**
Sample:
Depth: **3-4'**
Sample Description: Brown silty sand
Engineering Classification: Not requested
As-received water content (%): Not requested

Method: ASTM D698 B
Mold Id. Inc 2
Mold volume (ft^3): 0.0332

Preparation method: Moist
Rammer: Mechanical-circular face
Rock Correction: No

Optimum water content (%): **10.4**
Maximum dry unit weight (pcf): **124**

Point Number	+4%	+6%	+8%	+2%				
Wt. Sample + Mold (g)	6188.6	6226.7	6197.2	6107.8				
Wt. of Mold (g)	4163	4163	4163	4163				
Wet Unit Wt., γ_m (pcf)	134.4	137.0	135.0	129.1				
Wet Soil + Tare (g)	804.60	663.23	806.50	702.87				
Dry Soil + Tare (g)	747.35	608.96	726.45	664.48				
Tare (g)	127.56	123.03	123.82	124.00				
Water Content, w (%)	**9.2**	11.2	**13.3**	7.1				
Dry Unit Wt., γ_d (pcf)	**123.1**	123.2	**119.2**	120.5				



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Direct Shear Test for Soils Under Drained Conditions

(ASTM D3080)

IGES

Project: CS Mining Existing Facility Expansion
No: 01640-001 (II)
Location: Milford, UT
Date: 3/25/2013
By: JDF

Boring No.: TP-5
Sample:
Depth: 3-4' & 6'
Sample Description: Brown silty sand
Sample type: Laboratory compacted

Test type:	Inundated	
Lateral displacement (in.):	0.3	
Shear rate (in./min):	0.0200	
Specific gravity, Gs:	2.65	Assumed

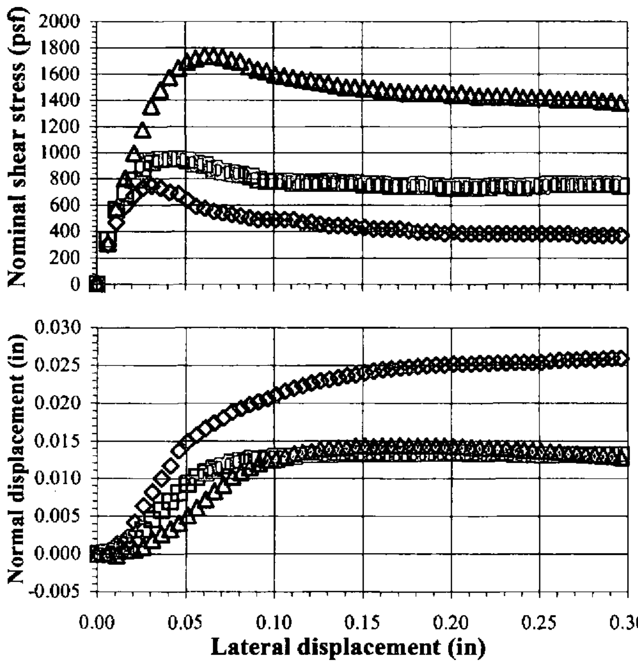
Dry unit weight	109.9	pcf
at	15.2	(%) w
Compaction specifications:	95% of ASTM D698B	

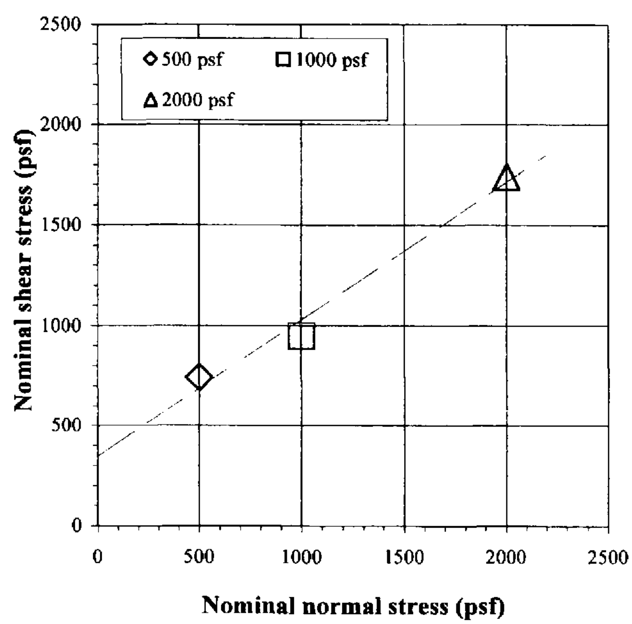
	Sample 1		Sample 2		Sample 3	
Nominal normal stress (psf)	500		1000		2000	
Peak shear stress (psf)	744		948		1740	
Lateral displacement at peak (in)	0.031		0.036		0.061	
	Initial	Pre-shear	Initial	Pre-shear	Initial	Pre-shear
Sample height (in)	1.0000	0.9908	1.0000	0.9844	1.0000	0.9833
Sample diameter (in)	2.416	2.416	2.416	2.416	2.416	2.416
Wt. rings + wet soil (g)	195.73	200.12	194.84	198.74	198.78	202.60
Wt. rings (g)	43.22	43.22	42.33	42.33	46.27	46.27
Wet soil + tare (g)	293.90	178.84	293.90	178.04	293.90	175.93
Dry soil + tare (g)	272.14	153.77	272.14	153.90	272.14	151.57
Tare (g)	128.56	21.12	128.56	22.22	128.56	20.91
Water content (%)	15.2	18.5	15.2	18.1	15.2	18.0
Dry unit weight (pcf)	110.1	111.0	110.1	111.7	110.1	111.9
Void ratio, e, for assumed Gs	0.50	0.49	0.50	0.48	0.50	0.48
Saturation (%)*	79.8	100.0	79.8	100.0	79.8	100.0

ϕ' (deg)	34
c' (psf)	348

Average of 3 samples	Initial	Pre-shear
Water content (%)	15.2	18.2
Dry unit weight (pcf)	110.1	111.5

*Pre-shear saturation set to 100% for phase calculations





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Nominal normal stress = 500 psf			Nominal normal stress = 1000 psf			Nominal normal stress = 2000 psf		
Lateral Displacement (in.)	Nominal Shear Stress (psf)	Normal Displacement (in.)	Lateral Displacement (in.)	Nominal Shear Stress (psf)	Normal Displacement (in.)	Lateral Displacement (in.)	Nominal Shear Stress (psf)	Normal Displacement (in.)
0	0	0.0000	0	0	0.0000	0	12	0.0000
0.006	300	0.0003	0.006	336	0.0002	0.006	312	0.0001
0.011	468	0.0013	0.011	564	0.0005	0.011	576	-0.0002
0.016	588	0.0020	0.016	696	0.0012	0.016	804	0.0004
0.021	672	0.0042	0.021	792	0.0021	0.021	996	0.0005
0.026	732	0.0064	0.026	876	0.0032	0.026	1176	0.0009
0.031	744	0.0082	0.031	924	0.0046	0.031	1356	0.0019
0.036	732	0.0100	0.036	948	0.0058	0.036	1476	0.0026
0.041	696	0.0117	0.041	948	0.0070	0.041	1572	0.0033
0.046	684	0.0137	0.046	948	0.0081	0.046	1644	0.0041
0.051	636	0.0149	0.051	936	0.0092	0.051	1692	0.0051
0.056	588	0.0158	0.056	912	0.0101	0.056	1716	0.0061
0.061	576	0.0167	0.061	900	0.0107	0.061	1740	0.0072
0.066	552	0.0174	0.066	876	0.0113	0.066	1740	0.0083
0.071	540	0.0180	0.071	852	0.0116	0.071	1728	0.0091
0.076	528	0.0188	0.076	840	0.0121	0.076	1704	0.0102
0.081	516	0.0193	0.081	828	0.0123	0.081	1692	0.0108
0.086	504	0.0198	0.087	816	0.0126	0.086	1656	0.0114
0.091	492	0.0202	0.091	792	0.0126	0.091	1632	0.0119
0.096	492	0.0206	0.096	780	0.0127	0.096	1620	0.0124
0.101	492	0.0211	0.101	780	0.0129	0.101	1596	0.0125
0.106	492	0.0216	0.106	780	0.0127	0.106	1584	0.0129
0.111	492	0.0220	0.111	768	0.0129	0.111	1572	0.0133
0.116	468	0.0223	0.116	768	0.0131	0.116	1560	0.0135
0.121	468	0.0227	0.121	768	0.0132	0.121	1548	0.0136
0.126	456	0.0230	0.126	768	0.0132	0.126	1536	0.0139
0.131	444	0.0232	0.131	780	0.0132	0.131	1524	0.0140
0.136	444	0.0234	0.136	768	0.0133	0.136	1512	0.0141
0.141	444	0.0237	0.141	768	0.0133	0.141	1500	0.0141
0.146	432	0.0238	0.146	768	0.0133	0.146	1500	0.0144
0.151	432	0.0241	0.151	756	0.0133	0.151	1488	0.0144
0.156	420	0.0243	0.156	756	0.0134	0.156	1488	0.0143
0.161	420	0.0245	0.161	756	0.0133	0.161	1476	0.0144
0.166	420	0.0246	0.166	744	0.0133	0.166	1464	0.0144
0.171	420	0.0247	0.171	744	0.0133	0.171	1464	0.0145
0.176	408	0.0248	0.176	744	0.0133	0.176	1452	0.0144
0.181	396	0.0249	0.181	756	0.0134	0.181	1452	0.0144
0.186	396	0.0250	0.186	744	0.0134	0.186	1452	0.0144
0.191	396	0.0251	0.191	744	0.0134	0.191	1452	0.0144
0.196	384	0.0251	0.196	732	0.0134	0.196	1452	0.0144
0.201	396	0.0252	0.201	732	0.0134	0.201	1440	0.0143
0.206	384	0.0252	0.206	744	0.0134	0.206	1452	0.0143
0.211	384	0.0252	0.211	732	0.0133	0.211	1440	0.0142
0.216	384	0.0253	0.216	732	0.0133	0.216	1428	0.0141
0.221	384	0.0253	0.221	732	0.0133	0.221	1428	0.0141
0.226	384	0.0253	0.226	744	0.0133	0.226	1428	0.0140
0.231	384	0.0253	0.231	744	0.0133	0.231	1428	0.0140
0.236	384	0.0254	0.236	732	0.0132	0.237	1428	0.0139
0.241	384	0.0254	0.241	732	0.0132	0.241	1416	0.0138
0.246	384	0.0254	0.246	744	0.0131	0.246	1416	0.0137
0.251	384	0.0254	0.251	744	0.0131	0.251	1416	0.0136
0.256	384	0.0256	0.256	756	0.0131	0.256	1416	0.0136
0.261	384	0.0257	0.261	756	0.0131	0.261	1404	0.0135
0.266	384	0.0258	0.266	756	0.0132	0.266	1404	0.0133
0.271	372	0.0258	0.271	756	0.0132	0.271	1404	0.0133
0.276	372	0.0259	0.276	756	0.0131	0.276	1404	0.0131
0.281	372	0.0258	0.281	756	0.0132	0.281	1404	0.0131
0.286	372	0.0259	0.286	756	0.0132	0.286	1392	0.0130
0.291	372	0.0260	0.291	756	0.0132	0.291	1392	0.0129
0.296	372	0.0260	0.296	744	0.0132	0.296	1380	0.0128
0.301	372	0.0261	0.301	756	0.0132	0.301	1392	0.0127

Direct Shear Test for Soils Under Drained Conditions

(ASTM D3080)

IGES

Project: CS Mining Existing Facility Expansion
No: 01640-001 (II)
Location: Milford, UT
Date: 3/25/2013
By: JDF

Boring No.: TP-8
Sample:
Depth: 3-4'

Sample Description: Brown silty sand
Sample type: Laboratory compacted
Dry unit weight 120.1 pcf
at 12.3 (%) w
Compaction specifications: 95% of ASTM D698B

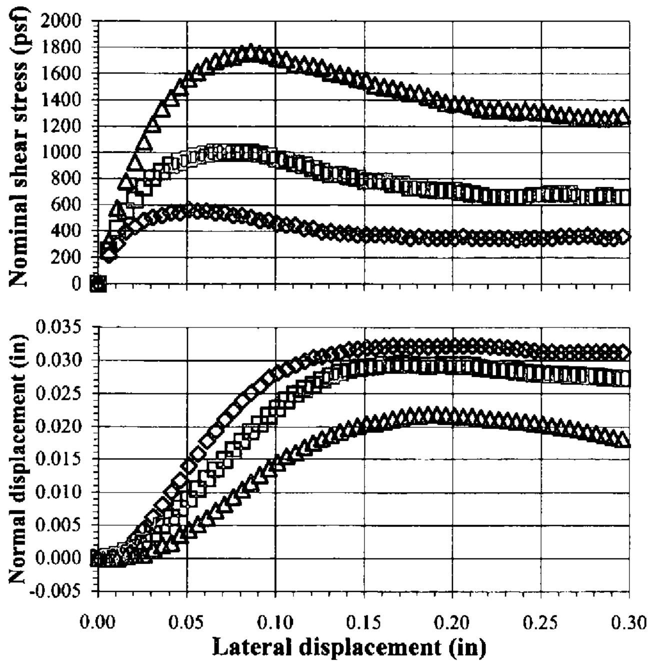
Test type: Inundated
Lateral displacement (in.): 0.3
Shear rate (in./min): 0.0172
Specific gravity, Gs: 2.65 Assumed

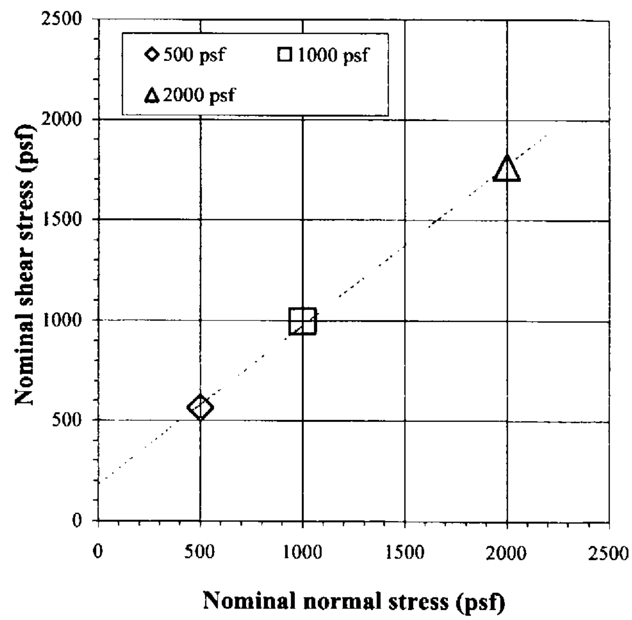
	Sample 1		Sample 2		Sample 3	
Nominal normal stress (psf)	500		1000		2000	
Peak shear stress (psf)	564		996		1764	
Lateral displacement at peak (in)	0.051		0.066		0.086	
	Initial	Pre-shear	Initial	Pre-shear	Initial	Pre-shear
Sample height (in)	1.0000	0.9950	1.0000	0.9903	1.0000	0.9859
Sample diameter (in)	2.416	2.416	2.416	2.416	2.416	2.416
Wt. rings + wet soil (g)	204.83	207.09	205.04	206.94	207.61	209.18
Wt. rings (g)	42.41	42.41	42.62	42.62	45.19	45.19
Wet soil + tare (g)	324.30	183.95	324.30	182.97	324.30	183.80
Dry soil + tare (g)	302.55	163.49	302.55	163.18	302.55	164.02
Tare (g)	127.94	21.06	127.94	20.67	127.94	21.78
Water content (%)	12.5	14.0	12.5	13.8	12.5	13.5
Dry unit weight (pcf)	120.0	120.6	120.0	121.1	120.0	121.7
Void ratio, e, for assumed Gs	0.38	0.37	0.38	0.37	0.38	0.36
Saturation (%)*	87.2	100.0	87.2	100.0	87.2	100.0

ϕ' (deg)	38
c' (psf)	180

Average of 3 samples	Initial	Pre-shear
Water content (%)	12.5	13.8
Dry unit weight (pcf)	120.0	121.1

*Pre-shear saturation set to 100% for phase calculations





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Reviewed:___________

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Nominal normal stress = 500 psf			Nominal normal stress = 1000 psf			Nominal normal stress = 2000 psf		
Lateral Displacement (in.)	Nominal Shear Stress (psf)	Normal Displacement (in.)	Lateral Displacement (in.)	Nominal Shear Stress (psf)	Normal Displacement (in.)	Lateral Displacement (in.)	Nominal Shear Stress (psf)	Normal Displacement (in.)
0	0	0.0000	0	0	0.0000	0	0	0.0000
0.006	216	0.0001	0.006	252	0.0003	0.006	324	-0.0001
0.011	300	0.0004	0.011	420	0.0006	0.011	576	-0.0001
0.016	396	0.0013	0.016	552	0.0011	0.016	780	0.0003
0.021	432	0.0030	0.021	636	0.0016	0.021	924	0.0005
0.026	480	0.0045	0.026	732	0.0026	0.026	1080	0.0006
0.031	504	0.0063	0.031	804	0.0037	0.031	1212	0.0014
0.036	516	0.0081	0.036	852	0.0050	0.036	1332	0.0020
0.041	540	0.0101	0.041	900	0.0062	0.041	1416	0.0023
0.046	540	0.0118	0.046	924	0.0076	0.046	1500	0.0035
0.051	564	0.0140	0.051	948	0.0090	0.051	1560	0.0043
0.056	552	0.0158	0.056	972	0.0105	0.056	1608	0.0052
0.061	552	0.0178	0.061	984	0.0121	0.061	1656	0.0061
0.066	540	0.0194	0.066	996	0.0135	0.066	1692	0.0072
0.071	540	0.0211	0.071	996	0.0149	0.071	1716	0.0082
0.076	516	0.0225	0.076	996	0.0164	0.076	1728	0.0093
0.081	516	0.0240	0.081	996	0.0178	0.081	1752	0.0104
0.086	504	0.0251	0.086	996	0.0192	0.086	1764	0.0115
0.091	480	0.0261	0.091	984	0.0204	0.091	1752	0.0126
0.096	480	0.0274	0.096	972	0.0217	0.096	1740	0.0136
0.101	456	0.0281	0.101	948	0.0228	0.101	1716	0.0145
0.106	444	0.0287	0.106	936	0.0240	0.106	1704	0.0154
0.111	444	0.0293	0.111	912	0.0249	0.111	1668	0.0160
0.116	420	0.0299	0.116	900	0.0257	0.116	1668	0.0168
0.121	420	0.0304	0.121	876	0.0263	0.121	1656	0.0175
0.126	396	0.0306	0.126	852	0.0271	0.126	1644	0.0182
0.131	396	0.0309	0.131	828	0.0277	0.131	1608	0.0187
0.136	384	0.0312	0.136	828	0.0282	0.136	1596	0.0192
0.141	384	0.0316	0.141	816	0.0286	0.141	1584	0.0197
0.146	372	0.0317	0.146	804	0.0289	0.146	1560	0.0201
0.151	372	0.0319	0.151	780	0.0290	0.151	1548	0.0205
0.156	372	0.0319	0.156	780	0.0291	0.156	1512	0.0206
0.161	372	0.0321	0.161	780	0.0293	0.161	1500	0.0209
0.166	372	0.0322	0.166	756	0.0293	0.166	1488	0.0212
0.171	360	0.0322	0.171	756	0.0295	0.171	1476	0.0215
0.176	348	0.0321	0.176	732	0.0294	0.176	1452	0.0217
0.181	360	0.0321	0.181	732	0.0293	0.181	1452	0.0218
0.186	348	0.0321	0.186	720	0.0292	0.186	1428	0.0219
0.191	348	0.0321	0.191	708	0.0293	0.191	1404	0.0219
0.196	348	0.0322	0.196	708	0.0294	0.196	1380	0.0218
0.201	348	0.0322	0.201	708	0.0292	0.201	1368	0.0217
0.206	360	0.0322	0.206	696	0.0293	0.206	1368	0.0216
0.211	348	0.0322	0.211	684	0.0292	0.211	1356	0.0216
0.216	348	0.0322	0.216	672	0.0289	0.216	1332	0.0214
0.221	348	0.0321	0.221	660	0.0287	0.221	1320	0.0212
0.226	348	0.0320	0.226	660	0.0286	0.226	1332	0.0211
0.231	348	0.0319	0.231	660	0.0285	0.231	1320	0.0210
0.236	336	0.0318	0.236	660	0.0284	0.236	1308	0.0209
0.241	348	0.0316	0.241	660	0.0282	0.241	1320	0.0208
0.246	348	0.0315	0.246	672	0.0281	0.246	1308	0.0206
0.251	348	0.0313	0.251	672	0.0280	0.251	1308	0.0204
0.256	348	0.0313	0.256	684	0.0279	0.256	1296	0.0202
0.261	360	0.0312	0.261	672	0.0279	0.261	1284	0.0200
0.266	360	0.0312	0.266	684	0.0278	0.266	1284	0.0198
0.271	360	0.0313	0.271	660	0.0278	0.271	1272	0.0196
0.276	372	0.0313	0.276	660	0.0277	0.276	1272	0.0193
0.281	360	0.0313	0.281	660	0.0277	0.281	1272	0.0190
0.286	348	0.0314	0.286	672	0.0275	0.286	1260	0.0187
0.291	348	0.0313	0.291	660	0.0274	0.291	1272	0.0184
0.296	360	0.0313	0.296	660	0.0273	0.296	1284	0.0182
0.301	348	0.0313	0.301	672	0.0270	0.301	1284	0.0180

Direct Shear Test for Soils Under Drained Conditions

(ASTM D3080)

IGES

Project: CS Mining Existing Facility Expansion
No: 01640-001 (II)
Location: Milford, UT
Date: 3/25/2013
By: JDF

Boring No.: TP-9
Sample:
Depth: 3-4'

Sample Description: Brown silty sand
Sample type: Laboratory compacted
Dry unit weight 117.8 pcf
at 12.4 (%) w
Compaction specifications: 95% of ASTM D698B

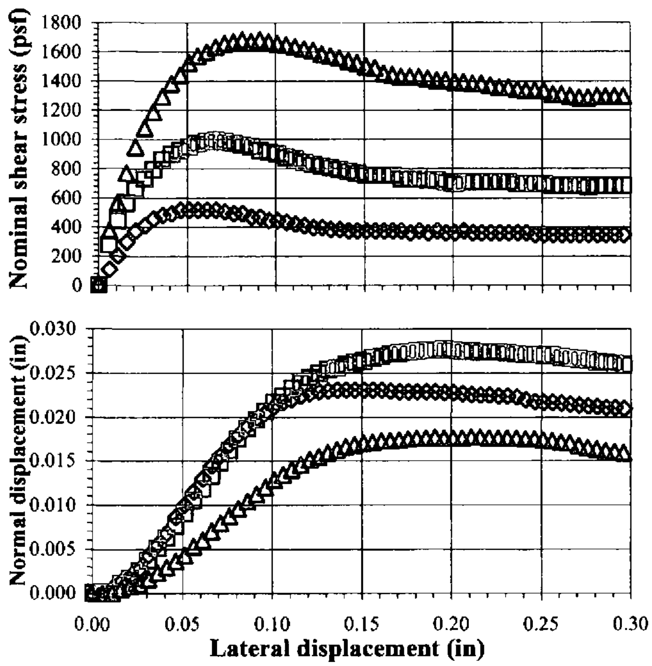
Test type: Inundated
Lateral displacement (in.): 0.3
Shear rate (in./min): 0.0172
Specific gravity, Gs: 2.65 Assumed

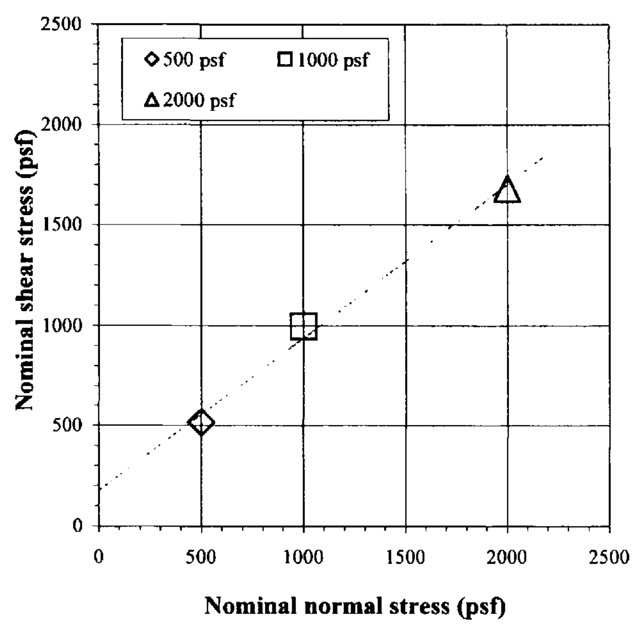
	Sample 1		Sample 2		Sample 3	
Nominal normal stress (psf)	500		1000		2000	
Peak shear stress (psf)	516		996		1680	
Lateral displacement at peak (in)	0.046		0.066		0.081	
	Initial	Pre-shear	Initial	Pre-shear	Initial	Pre-shear
Sample height (in)	1.0000	0.9937	1.0000	0.9894	1.0000	0.9838
Sample diameter (in)	2.416	2.416	2.416	2.416	2.416	2.416
Wt. rings + wet soil (g)	205.96	209.47	202.61	205.80	203.34	206.11
Wt. rings (g)	46.48	46.48	43.13	43.13	43.86	43.86
Wet soil + tare (g)	263.21	181.72	263.21	181.24	263.21	182.40
Dry soil + tare (g)	247.90	161.22	247.90	161.33	247.90	162.60
Tare (g)	124.46	21.06	124.46	21.30	124.46	22.49
Water content (%)	12.4	14.9	12.4	14.7	12.4	14.4
Dry unit weight (pcf)	117.9	118.6	117.9	119.1	117.9	119.8
Void ratio, e, for assumed Gs	0.40	0.39	0.40	0.39	0.40	0.38
Saturation (%)*	81.5	100.0	81.5	100.0	81.5	100.0

ϕ' (deg)	37
c' (psf)	174

Average of 3 samples	Initial	Pre-shear
Water content (%)	12.4	14.6
Dry unit weight (pcf)	117.9	119.2

*Pre-shear saturation set to 100% for phase calculations





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Nominal normal stress = 500 psf			Nominal normal stress = 1000 psf			Nominal normal stress = 2000 psf		
Lateral Displacement (in.)	Nominal Shear Stress (psf)	Normal Displacement (in.)	Lateral Displacement (in.)	Nominal Shear Stress (psf)	Normal Displacement (in.)	Lateral Displacement (in.)	Nominal Shear Stress (psf)	Normal Displacement (in.)
0	0	0.0000	0	0	0.0000	0	12	0.0000
0.006	108	0.0002	0.006	276	0.0002	0.006	372	0.0000
0.011	204	0.0006	0.011	444	0.0002	0.011	564	0.0000
0.016	300	0.0013	0.016	564	0.0011	0.016	768	0.0005
0.021	372	0.0019	0.021	660	0.0017	0.021	948	0.0008
0.026	408	0.0027	0.026	732	0.0026	0.026	1080	0.0010
0.031	456	0.0043	0.031	792	0.0037	0.031	1188	0.0016
0.036	480	0.0055	0.036	864	0.0051	0.036	1296	0.0023
0.041	492	0.0068	0.041	900	0.0063	0.041	1380	0.0029
0.046	516	0.0086	0.046	924	0.0076	0.046	1440	0.0036
0.051	516	0.0100	0.051	948	0.0090	0.051	1524	0.0043
0.056	516	0.0115	0.056	972	0.0105	0.056	1572	0.0053
0.061	516	0.0130	0.061	984	0.0118	0.061	1596	0.0060
0.066	516	0.0144	0.066	996	0.0133	0.066	1632	0.0070
0.071	504	0.0156	0.071	984	0.0148	0.071	1656	0.0079
0.076	492	0.0168	0.076	972	0.0161	0.076	1668	0.0087
0.081	492	0.0179	0.081	960	0.0175	0.081	1680	0.0096
0.086	468	0.0190	0.086	948	0.0187	0.086	1668	0.0104
0.091	468	0.0198	0.091	924	0.0197	0.091	1680	0.0112
0.096	444	0.0205	0.096	912	0.0207	0.096	1668	0.0120
0.101	444	0.0212	0.101	900	0.0217	0.101	1656	0.0128
0.106	432	0.0217	0.106	876	0.0224	0.106	1644	0.0134
0.111	420	0.0220	0.111	864	0.0233	0.111	1632	0.0140
0.116	408	0.0224	0.116	840	0.0239	0.116	1620	0.0145
0.121	396	0.0227	0.121	828	0.0245	0.121	1608	0.0151
0.126	396	0.0229	0.126	816	0.0250	0.126	1584	0.0154
0.131	384	0.0230	0.131	804	0.0254	0.131	1572	0.0159
0.136	384	0.0231	0.136	792	0.0256	0.136	1560	0.0162
0.141	372	0.0231	0.141	780	0.0260	0.141	1536	0.0166
0.146	372	0.0231	0.146	768	0.0262	0.146	1524	0.0168
0.151	372	0.0231	0.151	756	0.0264	0.151	1500	0.0170
0.156	372	0.0231	0.156	756	0.0267	0.156	1488	0.0171
0.161	372	0.0231	0.161	756	0.0269	0.161	1452	0.0173
0.166	372	0.0230	0.166	756	0.0272	0.166	1440	0.0173
0.171	372	0.0229	0.171	732	0.0273	0.171	1428	0.0174
0.176	360	0.0229	0.176	732	0.0274	0.176	1428	0.0175
0.181	372	0.0229	0.181	732	0.0275	0.181	1428	0.0176
0.186	360	0.0229	0.186	720	0.0276	0.186	1416	0.0176
0.191	372	0.0229	0.191	720	0.0276	0.191	1404	0.0177
0.196	360	0.0228	0.196	708	0.0277	0.196	1404	0.0176
0.201	360	0.0228	0.201	696	0.0276	0.201	1392	0.0176
0.206	372	0.0227	0.206	708	0.0275	0.206	1392	0.0176
0.211	360	0.0226	0.211	708	0.0275	0.211	1380	0.0177
0.216	360	0.0225	0.216	708	0.0274	0.216	1380	0.0177
0.221	360	0.0225	0.221	708	0.0274	0.221	1368	0.0176
0.226	360	0.0224	0.226	708	0.0274	0.226	1356	0.0176
0.231	360	0.0224	0.231	708	0.0273	0.231	1356	0.0176
0.236	360	0.0223	0.236	696	0.0272	0.236	1344	0.0176
0.241	360	0.0220	0.241	696	0.0271	0.241	1332	0.0175
0.246	348	0.0218	0.246	696	0.0271	0.246	1332	0.0175
0.251	348	0.0217	0.251	696	0.0270	0.251	1332	0.0174
0.256	348	0.0217	0.256	684	0.0270	0.256	1308	0.0173
0.261	348	0.0216	0.261	684	0.0268	0.261	1308	0.0171
0.266	348	0.0215	0.266	684	0.0267	0.266	1296	0.0170
0.271	348	0.0214	0.271	684	0.0266	0.271	1284	0.0167
0.276	348	0.0213	0.276	672	0.0265	0.276	1284	0.0165
0.281	348	0.0212	0.281	684	0.0263	0.281	1296	0.0163
0.286	348	0.0211	0.286	684	0.0262	0.286	1296	0.0161
0.291	348	0.0211	0.291	684	0.0261	0.291	1296	0.0160
0.296	348	0.0210	0.296	684	0.0259	0.296	1296	0.0159
0.301	348	0.0210	0.301	684	0.0257	0.301	1284	0.0157

Direct Shear Test for Soils Under Drained Conditions

(ASTM D3080)

IGES

Project: CS Mining Existing Facility Expansion
No: 01640-001 (II)
Location: Milford, UT
Date: 3/14/2013
By: JDF

Boring No.: Tailings Beach
Sample: 7
Depth: Surface
Sample Description: Grey silty sand
Sample type: Undisturbed-trimmed from thin-wall

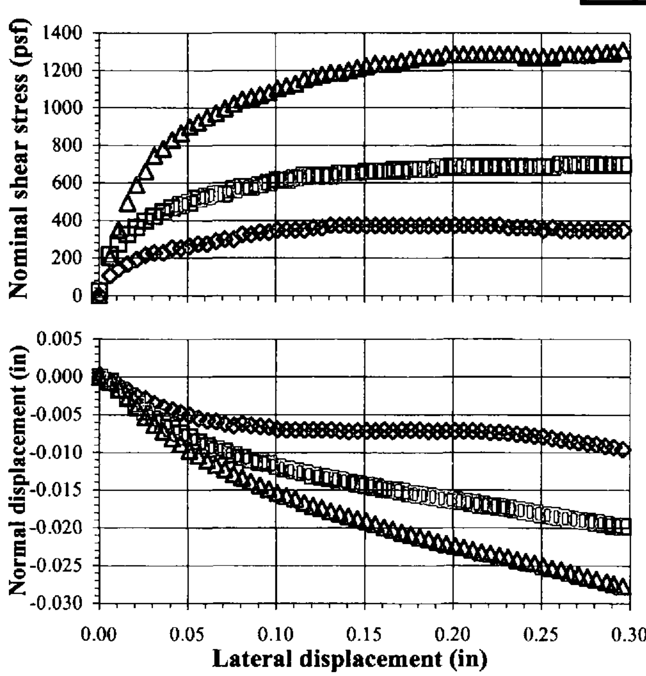
Test type:	Inundated	
Lateral displacement (in.):	0.3	
Shear rate (in./min):	0.0200	
Specific gravity, Gs:	3.13	Measured

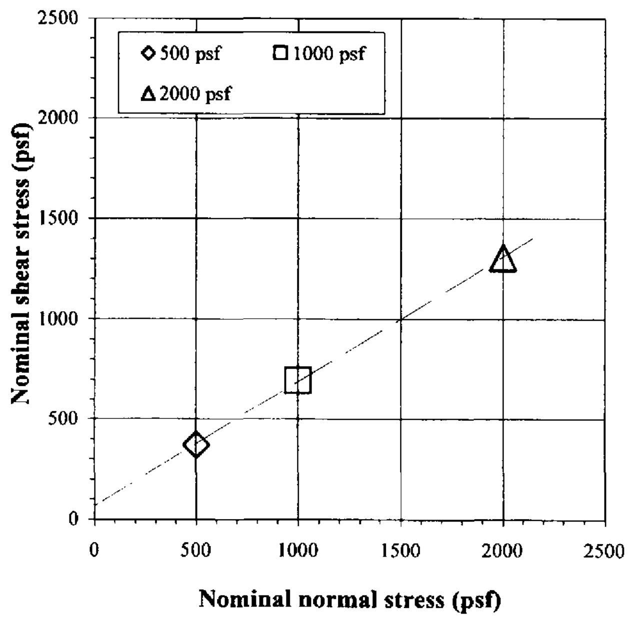
	Sample 1		Sample 2		Sample 3	
Nominal normal stress (psf)	500		1000		2000	
Peak shear stress (psf)	372		696		1308	
Lateral displacement at peak (in)	0.131		0.261		0.296	
	Initial	Pre-shear	Initial	Pre-shear	Initial	Pre-shear
Sample height (in)	1.0000	0.9855	1.0000	0.9557	1.0000	0.9367
Sample diameter (in)	2.416	2.416	2.416	2.416	2.416	2.416
Wt. rings + wet soil (g)	195.82	197.17	198.90	198.41	198.12	194.84
Wt. rings (g)	42.34	42.34	46.26	46.26	42.62	42.62
Wet soil + tare (g)	226.12	167.10	226.12	157.01	226.12	163.74
Dry soil + tare (g)	203.63	134.53	203.63	130.60	203.63	138.64
Tare (g)	127.02	21.05	127.02	20.68	127.02	21.76
Water content (%)	29.4	30.5	29.4	28.9	29.4	26.6
Dry unit weight (pcf)	98.6	100.0	98.1	102.6	99.9	106.6
Void ratio, e, for assumed Gs	0.98	0.96	1.00	0.91	0.96	0.83
Saturation (%)*	93.5	100.0	92.4	100.0	96.0	100.0

φ' (deg)	32
c' (psf)	66

Average of 3 samples	Initial	Pre-shear
Water content (%)	29.4	28.7
Dry unit weight (pcf)	98.8	103.1

*Pre-shear saturation set to 100% for phase calculations





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Nominal normal stress = 500 psf			Nominal normal stress = 1000 psf			Nominal normal stress = 2000 psf		
Lateral Displacement (in.)	Nominal Shear Stress (psf)	Normal Displacement (in.)	Lateral Displacement (in.)	Nominal Shear Stress (psf)	Normal Displacement (in.)	Lateral Displacement (in.)	Nominal Shear Stress (psf)	Normal Displacement (in.)
0	0	0.0002	0	24	-0.0001	0	0	0.0001
0.006	108	-0.0005	0.006	216	-0.0006	0.006	204	-0.0007
0.011	144	-0.0011	0.011	276	-0.0017	0.011	348	-0.0016
0.016	168	-0.0018	0.016	324	-0.0027	0.016	492	-0.0028
0.021	192	-0.0025	0.021	360	-0.0037	0.021	588	-0.0040
0.026	216	-0.0029	0.026	396	-0.0046	0.026	660	-0.0053
0.031	228	-0.0035	0.031	420	-0.0053	0.031	744	-0.0063
0.036	228	-0.0040	0.036	444	-0.0060	0.036	780	-0.0072
0.041	252	-0.0043	0.041	468	-0.0067	0.041	828	-0.0081
0.046	252	-0.0047	0.046	480	-0.0074	0.046	864	-0.0088
0.051	264	-0.0050	0.051	492	-0.0079	0.051	900	-0.0097
0.056	276	-0.0054	0.056	516	-0.0085	0.056	924	-0.0104
0.061	276	-0.0057	0.061	528	-0.0090	0.061	948	-0.0111
0.066	288	-0.0059	0.066	540	-0.0095	0.066	972	-0.0117
0.071	300	-0.0062	0.071	540	-0.0098	0.071	996	-0.0123
0.076	300	-0.0064	0.076	564	-0.0103	0.076	1020	-0.0129
0.081	324	-0.0062	0.081	576	-0.0106	0.081	1044	-0.0134
0.086	324	-0.0064	0.086	576	-0.0110	0.086	1056	-0.0139
0.091	336	-0.0065	0.091	588	-0.0113	0.091	1068	-0.0144
0.096	336	-0.0066	0.096	600	-0.0115	0.096	1080	-0.0149
0.101	348	-0.0069	0.101	612	-0.0119	0.101	1104	-0.0154
0.106	348	-0.0070	0.106	612	-0.0122	0.106	1116	-0.0158
0.111	348	-0.0070	0.111	624	-0.0125	0.111	1128	-0.0162
0.116	348	-0.0070	0.116	636	-0.0127	0.116	1152	-0.0167
0.121	360	-0.0070	0.121	636	-0.0131	0.121	1164	-0.0171
0.126	360	-0.0070	0.126	636	-0.0133	0.126	1176	-0.0174
0.131	372	-0.0070	0.131	636	-0.0135	0.131	1188	-0.0178
0.136	372	-0.0071	0.136	648	-0.0137	0.136	1188	-0.0181
0.141	372	-0.0072	0.141	648	-0.0140	0.141	1200	-0.0185
0.146	372	-0.0071	0.146	648	-0.0142	0.146	1212	-0.0188
0.151	372	-0.0071	0.151	660	-0.0144	0.151	1224	-0.0191
0.156	372	-0.0071	0.156	660	-0.0146	0.156	1236	-0.0195
0.161	372	-0.0070	0.161	660	-0.0149	0.161	1236	-0.0199
0.166	372	-0.0071	0.167	672	-0.0150	0.166	1236	-0.0202
0.171	372	-0.0070	0.171	660	-0.0152	0.171	1248	-0.0206
0.176	372	-0.0070	0.176	672	-0.0155	0.176	1260	-0.0209
0.181	372	-0.0070	0.181	672	-0.0156	0.181	1272	-0.0212
0.186	372	-0.0071	0.186	672	-0.0158	0.186	1272	-0.0215
0.191	372	-0.0071	0.191	684	-0.0160	0.191	1272	-0.0218
0.196	372	-0.0071	0.196	684	-0.0162	0.196	1284	-0.0221
0.201	372	-0.0071	0.201	684	-0.0164	0.201	1284	-0.0224
0.206	372	-0.0071	0.206	684	-0.0165	0.206	1284	-0.0226
0.211	372	-0.0071	0.211	684	-0.0167	0.211	1284	-0.0229
0.216	372	-0.0072	0.216	684	-0.0169	0.216	1284	-0.0232
0.221	372	-0.0073	0.221	684	-0.0171	0.221	1284	-0.0234
0.226	372	-0.0073	0.226	684	-0.0172	0.226	1284	-0.0237
0.231	360	-0.0074	0.231	684	-0.0174	0.231	1284	-0.0239
0.236	360	-0.0075	0.236	684	-0.0176	0.236	1284	-0.0242
0.241	360	-0.0076	0.241	684	-0.0178	0.241	1272	-0.0245
0.246	360	-0.0078	0.246	684	-0.0180	0.246	1272	-0.0247
0.251	348	-0.0079	0.251	684	-0.0182	0.251	1272	-0.0250
0.256	360	-0.0081	0.256	684	-0.0184	0.256	1272	-0.0253
0.261	348	-0.0083	0.261	696	-0.0186	0.261	1284	-0.0256
0.266	348	-0.0084	0.266	696	-0.0188	0.266	1284	-0.0259
0.271	348	-0.0086	0.271	696	-0.0190	0.271	1284	-0.0262
0.276	348	-0.0087	0.276	696	-0.0191	0.276	1284	-0.0265
0.281	348	-0.0089	0.281	696	-0.0193	0.281	1296	-0.0268
0.286	348	-0.0091	0.286	696	-0.0195	0.287	1296	-0.0271
0.291	348	-0.0092	0.291	696	-0.0197	0.291	1296	-0.0274
0.296	348	-0.0095	0.296	696	-0.0198	0.296	1308	-0.0277
0.301	348	-0.0096	0.301	684	-0.0200	0.301	1308	-0.0279

Consolidated Undrained Triaxial Compression Test for Cohesive Soils

(*ASTM D4767*)

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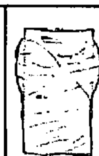
Project: **CS Mining Existing Facility**
No: **01640-001(II)**
Location: Milford, UT
Date: 3/25/2013
By: MP

Boring No.: **TP-3**
Sample:
Depth: **1-3'**
Sample Description: Brown silty sand
Engineering Classification: Not requested
Sample type: Laboratory compacted

	Test Number:	S1	S2	S3
Initial	Height, H (in)	5.970	5.989	5.997
	Diameter, D (in)	2.422	2.420	2.420
	Water content, w (%)	12.1	12.1	12.1
	Dry unit weight, γ_d (pcf)	121.4	121.2	121.1
	Saturation (%)	88.4	88.0	87.6
	Void ratio, e	0.36	0.36	0.37
	Mounting	Wet	Wet	Wet
Before shear	Water content, w (%)	14.7	14.6	14.6
	Dry unit weight, γ_d (pcf)	119.1	119.2	119.3
	Saturation[a] (%)	100.0	100.0	100.0
	Void ratio, e	0.39	0.39	0.39
	Area, A_{eoc} (in^2)	4.69	4.72	4.65
	Area method	A	A	A
	B	0.95	0.95	0.95
	t_{50} (min)	0.15	0.15	0.11
	Back pressure (psf)	6407	9791	6912
	Strain rate (%/min)	0.06	0.06	0.06
	Time to failure (min)	333.3	78.3	66.7
	Strain at failure, ε_f (%)	20.00	4.70	4.00
	Filter paper correction	No	No	No
	Membrane correction	Yes	Yes	Yes
Assumed specific gravity	2.65			

[a] Saturation set to 100% for phase calculations

Summary of strength parameters at peak deviator stress		
Total stress	c (psf)	1076
	ϕ (deg)	19.5
Effective stress	c' (psf)	77
	ϕ' (deg)	37.1

Comments:

Specimens were compacted to 95% of the MDUW at OWC +2%. The maximum dry unit weight and optimum water content from the Proctor test was 127.5 pcf and 10.3% respectively.

Tested by:__________

Reviewed:__________

Z:\PROJECTS\01640_CS_mining\001_Tailings\II\[GTXCU3v2_TP-3_1-3.xls]Summary

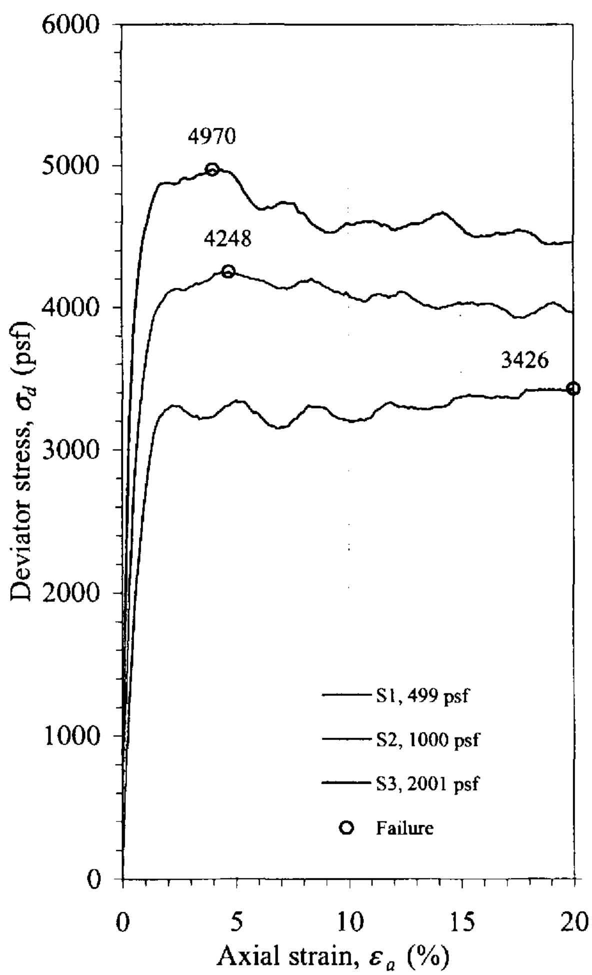
Consolidated Undrained Triaxial Compression Test for Cohesive Soils

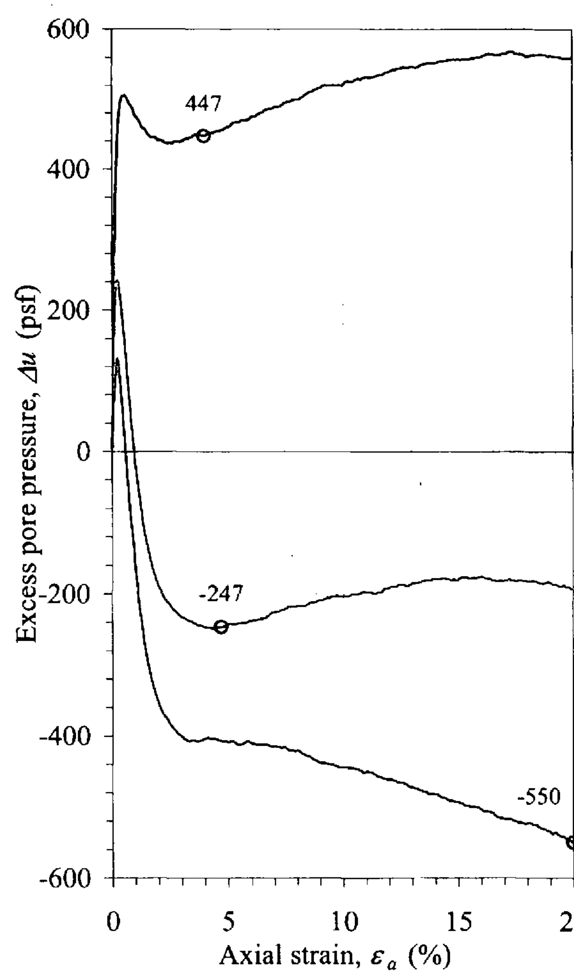
(*ASTM D4767*)

Project: CS Mining Existing Facility
No: 01640-001(II)
Location: Milford, UT

Boring No.: TP-3
Sample:
Depth: 1-3'

	Test Number:	S1	S2	S3
Total stress	σ_3 (psf)	499	1000	2001
	σ_1-σ_3 (psf)	3426	4248	4970
	σ_1 (psf)	3925	5248	6972
	$q = (\sigma_1 - \sigma_3)/2$ (psf)	1713	2124	2485
	$p = (\sigma_1 + \sigma_3)/2$ (psf)	2212	3124	4486
Effective stress	Δu (psf)	-550	-247	447
	σ'_3 (psf)	1049	1247	1555
	σ'_1-σ'_3 (psf)	3426	4248	4970
	σ'_1 (psf)	4475	5494	6525
	$q = (\sigma'_1 - \sigma'_3)/2$ (psf)	1713	2124	2485
	$p' = (\sigma'_1 + \sigma'_3)/2$ (psf)	2762	3371	4040
	σ'_1/σ'_3	4.26	4.41	4.20
	$A = \Delta u/(\sigma_1 - \sigma_3)$	-0.161	-0.058	0.090





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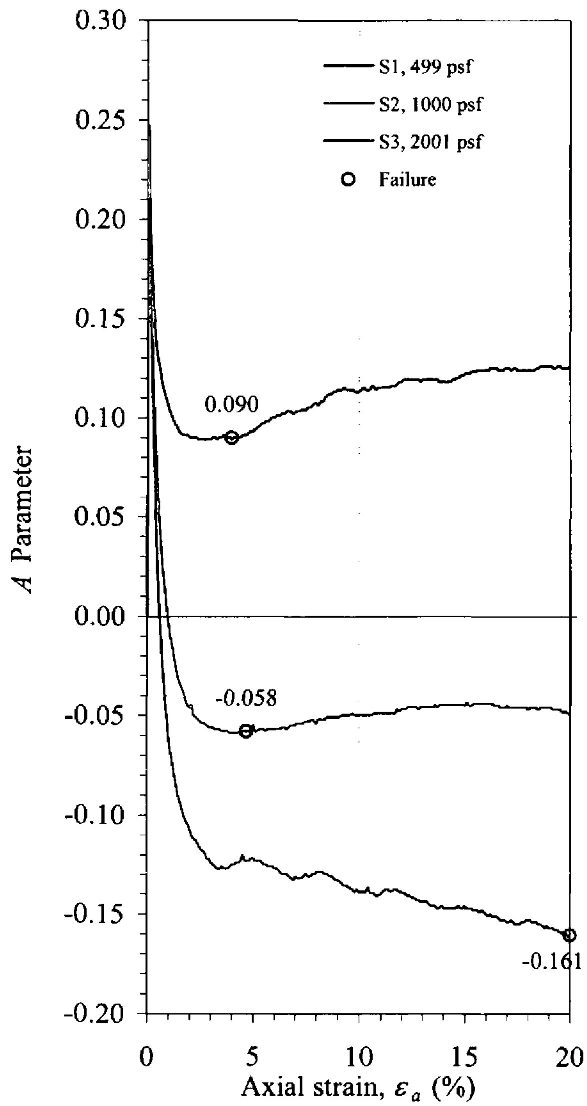
Consolidated Undrained Triaxial Compression Test for Cohesive Soils

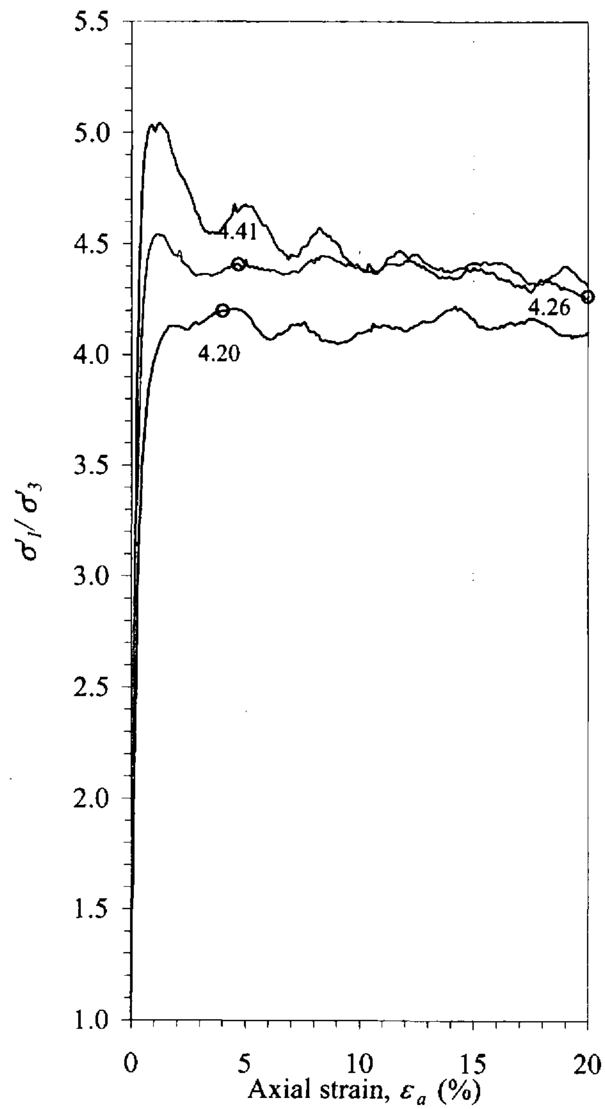
(ASTM D4767)

Project: CS Mining Existing Facility
No: 01640-001(II)
Location: Milford, UT

Boring No.: TP-3
Sample:
Depth: 1-3'

Summary of strength parameters at peak deviator stress		
Total stress	c (psf)	1076
	ϕ (deg)	19.5
Effective stress	c' (psf)	77
	ϕ' (deg)	37.1





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Consolidated Undrained Triaxial Compression Test for Cohesive Soils

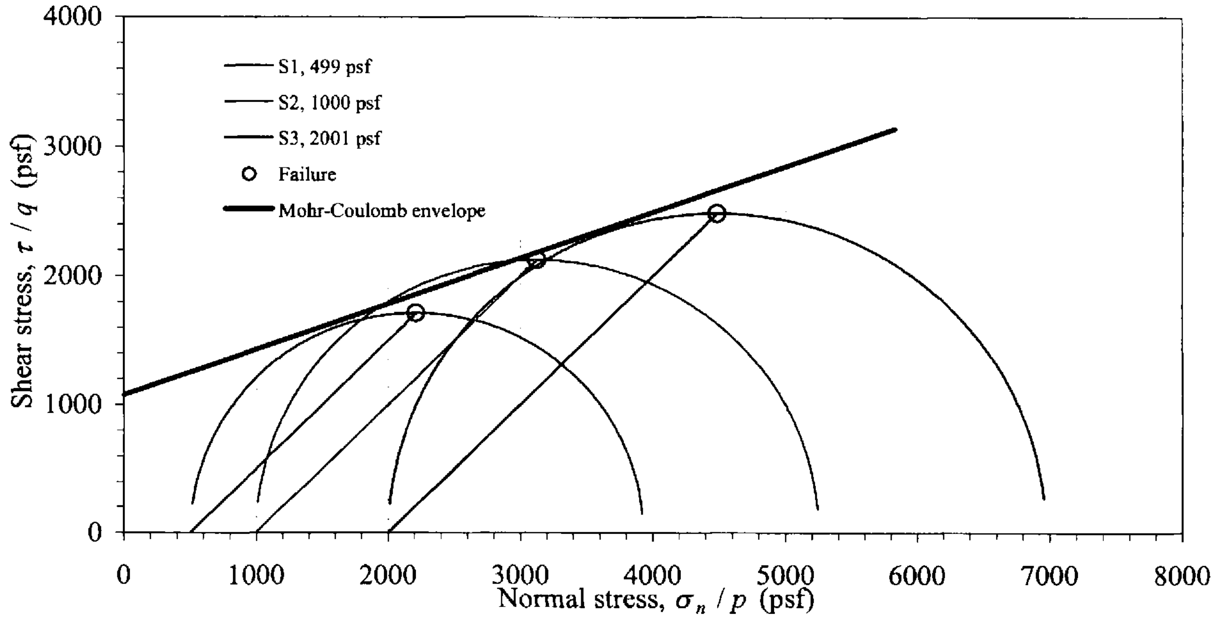
(*ASTM D4767*)

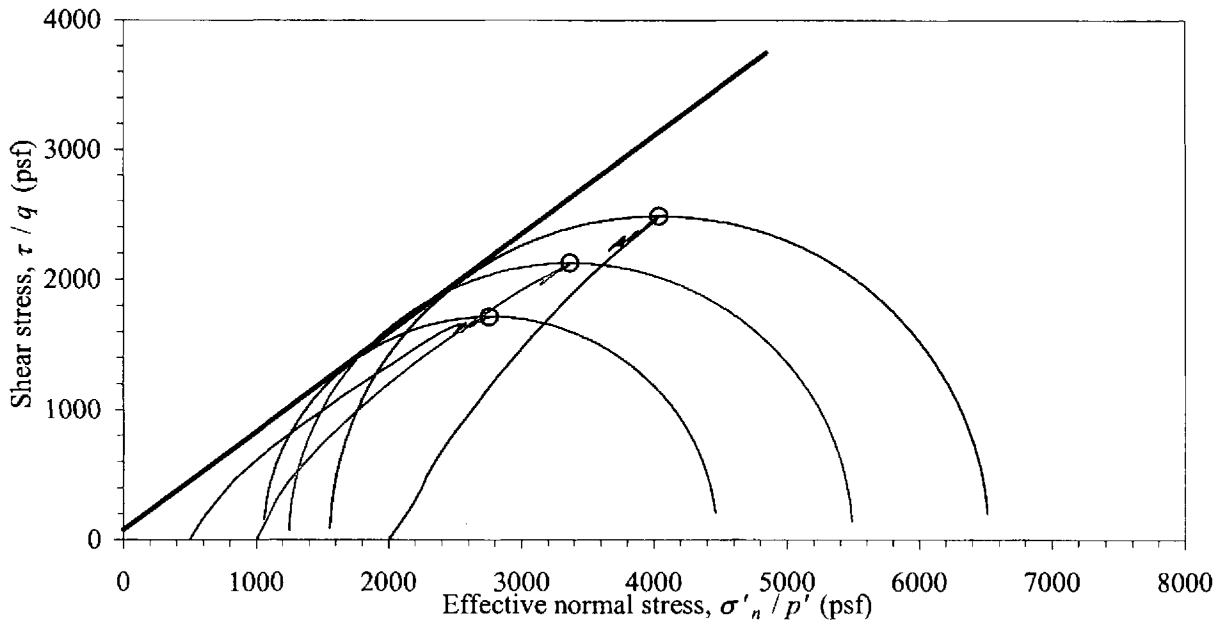
IGES

Project: CS Mining Existing Facility
No: 01640-001(II)
Location: Milford, UT

Boring No.: TP-3
Sample:
Depth: 1-3'

Summary of strength parameters at peak deviator stress		
Total stress	c (psf)	1076
	ϕ (deg)	19.5
Effective stress	c' (psf)	77
	ϕ' (deg)	37.1





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Consolidated Undrained Triaxial Compression Test for Cohesive Soils

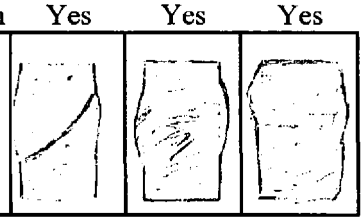
(ASTM D4767)

Project: **CS Mining Existing Facility Expansion**
No: **01640-001 (II)**
Location: Milford, UT
Date: 3/22/2013
By: MP

Boring No.: **TP-6**
Sample:
Depth: **2-6'**
Sample Description: Brown silty sand
Engineering Classification: Not requested
Sample type: Laboratory compacted

	Test Number:	S1	S2	S3
Initial	Height, H (in)	6.000	5.994	5.976
	Diameter, D (in)	2.419	2.421	2.419
	Water content, w (%)	16.5	16.5	16.5
	Dry unit weight, γ_d (pcf)	109.5	109.4	109.7
	Saturation (%)	85.8	85.6	86.3
	Void ratio, e	0.51	0.51	0.51
	Mounting	Wet	Wet	Wet
Before shear	Water content, w (%)	20.0	19.7	20.0
	Dry unit weight, γ_d (pcf)	108.2	108.7	108.1
	Saturation[a] (%)	100.0	100.0	100.0
	Void ratio, e	0.53	0.52	0.53
	Area, A_{eoc} (in^2)	4.64	4.63	4.65
	Area method	A	A	A
	B	0.95	0.95	0.95
	t_{50} (min)	0.10	0.09	0.11
	Back pressure (psf)	7632	9790	8351
	Strain rate (%/min)	0.06	0.06	0.06
	Time to failure (min)	241.7	295.0	80.0
	Strain at failure, ε_f (%)	14.50	17.70	4.80
	Filter paper correction	No	No	No
	Membrane correction	Yes	Yes	Yes

Assumed specific gravity 2.65



[a] Saturation set to 100% for phase calculations

Summary of strength parameters at peak deviator stress		
Total stress	c (psf)	1034
	ϕ (deg)	27.0
Effective stress	c' (psf)	0
	ϕ' (deg)	39.0

Comments:
Specimens were compacted to 95% of the MDUW at OWC +2%. The maximum dry unit weight and optimum water content from the Proctor test was 115.5 pcf and 14.5% respectively.

Tested by:__________
Reviewed:__________

Z:\PROJECTS\01640_CS_mining\001_Tailings\II\[GTXCU3v2_TP-6_2-6.xls]Summary

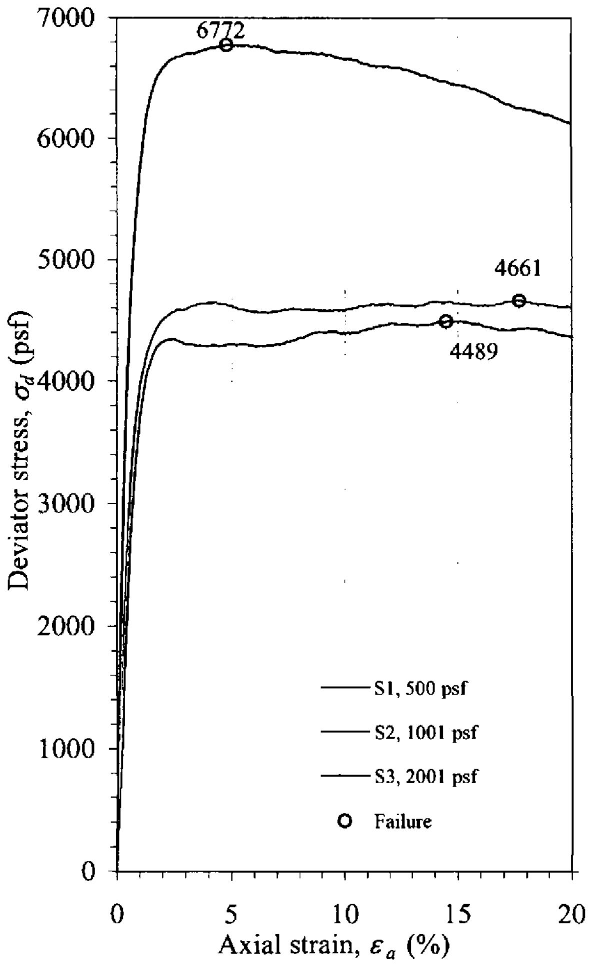
Consolidated Undrained Triaxial Compression Test for Cohesive Soils

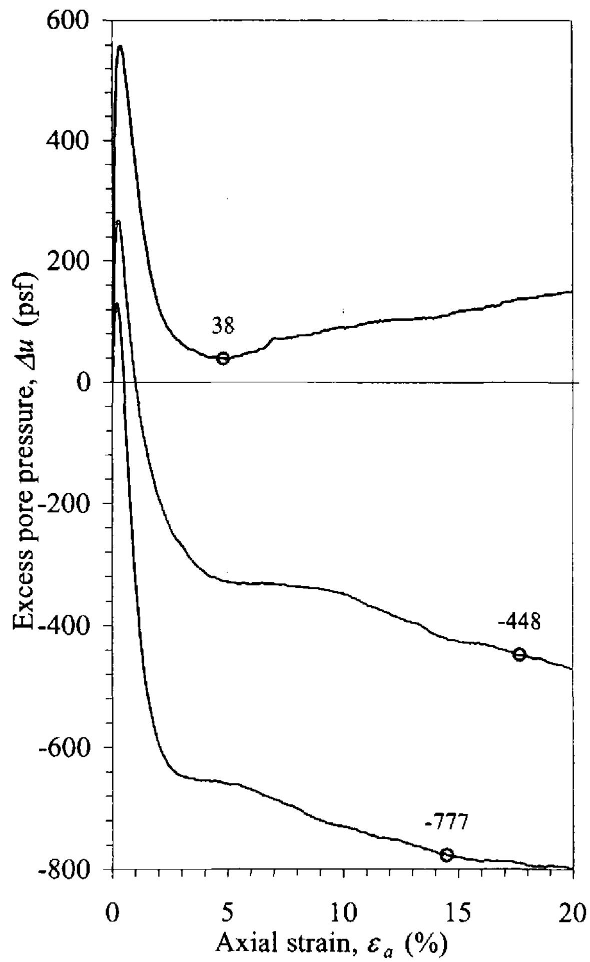
(*ASTM D4767*)

Project: CS Mining Existing Facility Expansion
No: 01640-001 (II)
Location: Milford, UT

Boring No.: TP-6
Sample:
Depth: 2-6'

	Test Number:	S1	S2	S3
Total stress	σ_3 (psf)	500	1001	2001
	σ_1-σ_3 (psf)	4489	4661	6772
	σ_1 (psf)	4989	5662	8773
	$q = (\sigma_1 - \sigma_3)/2$ (psf)	2245	2330	3386
	$p = (\sigma_1 + \sigma_3)/2$ (psf)	2744	3331	5387
Effective stress	Δu (psf)	-777	-448	38
	σ'_3 (psf)	1277	1449	1963
	σ'_1-σ'_3 (psf)	4489	4661	6772
	σ'_1 (psf)	5766	6110	8736
	$q = (\sigma'_1 - \sigma'_3)/2$ (psf)	2245	2330	3386
	$p' = (\sigma'_1 + \sigma'_3)/2$ (psf)	3521	3780	5349
	σ'_1/σ'_3	4.52	4.22	4.45
	$A = \Delta u/(\sigma_1 - \sigma_3)$	-0.173	-0.096	0.006





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Consolidated Undrained Triaxial Compression Test for Cohesive Soils

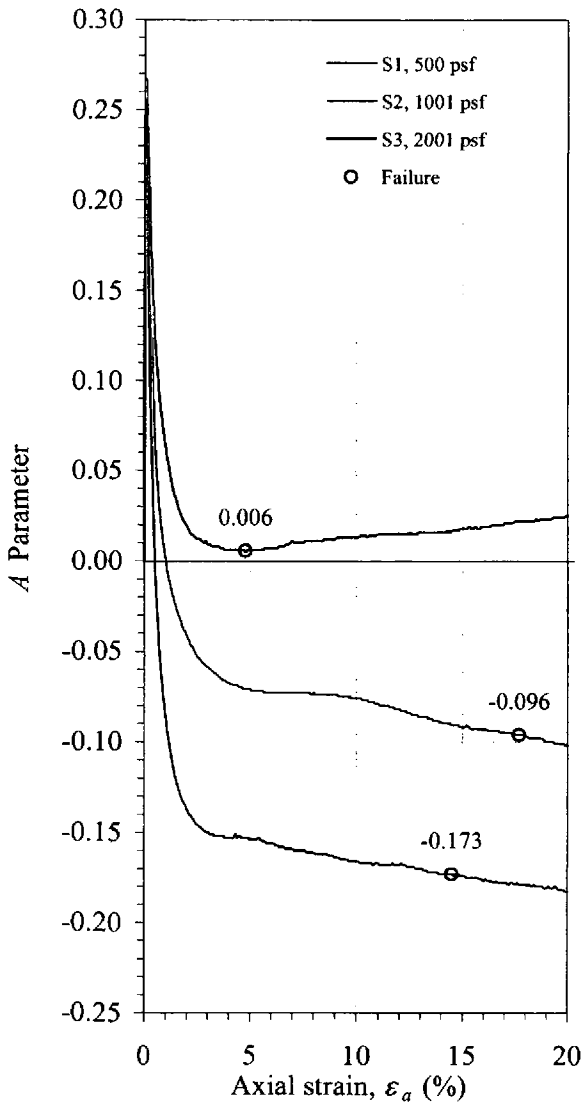
(*ASTM D4767*)

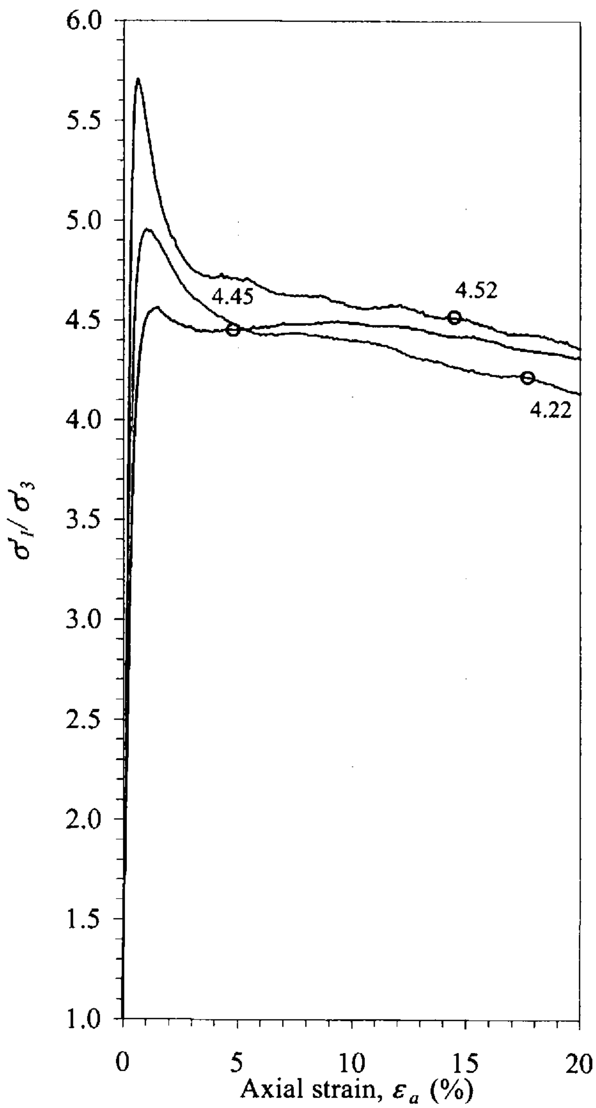
IGES

Project: CS Mining Existing Facility Expansion
No: 01640-001 (II)
Location: Milford, UT

Boring No.: TP-6
Sample:
Depth: 2-6'

Summary of strength parameters at peak deviator stress		
Total stress	c (psf)	1034
	ϕ (deg)	27.0
Effective stress	c' (psf)	0
	ϕ' (deg)	39.0





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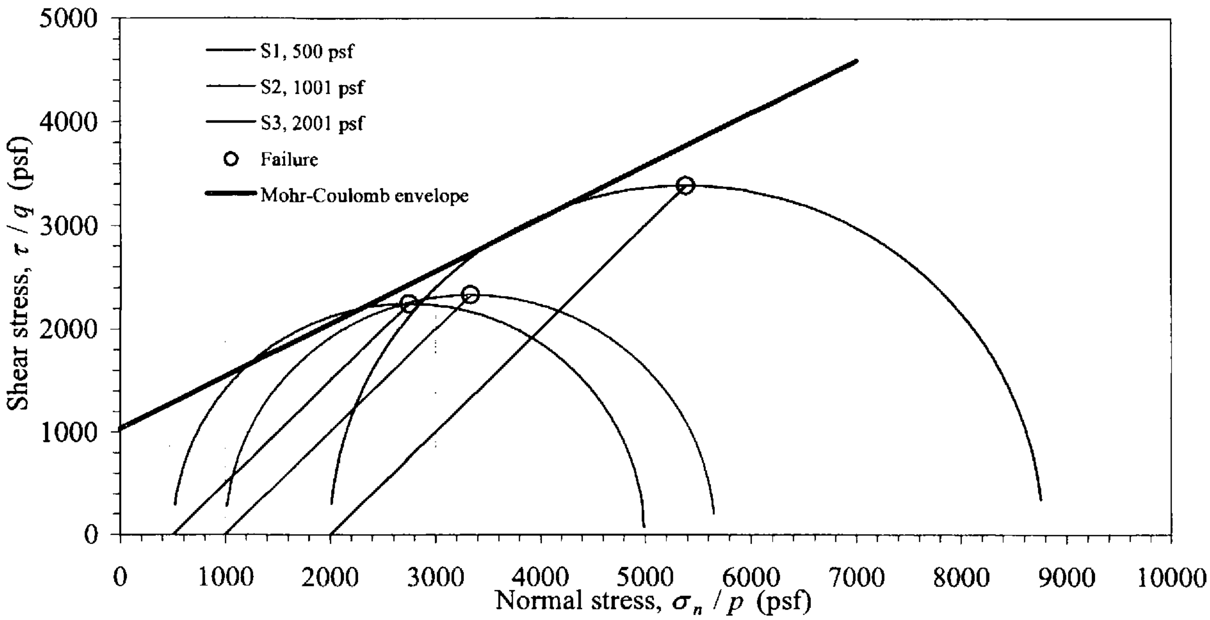
Consolidated Undrained Triaxial Compression Test for Cohesive Soils

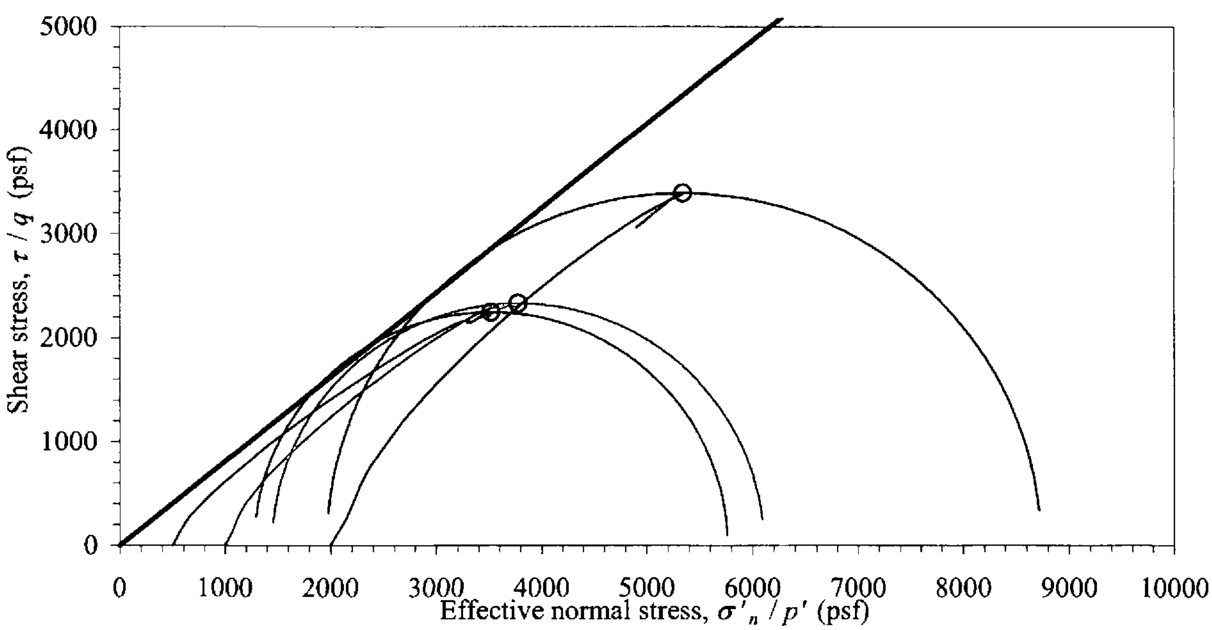
(*ASTM D4767*)

Project: CS Mining Existing Facility Expansion
No: 01640-001 (II)
Location: Milford, UT

Boring No.: TP-6
Sample:
Depth: 2-6'

Summary of strength parameters at peak deviator stress		
Total stress	c (psf)	1034
	ϕ (deg)	27.0
Effective stress	c' (psf)	0
	ϕ' (deg)	39.0





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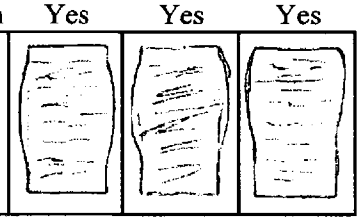
Consolidated Undrained Triaxial Compression Test for Cohesive Soils

(*ASTM D4767*)

Project: **CS Mining Existing Facility Expansion**
No: **01640-001 (II)**
Location: Milford, UT
Date: 3/25/2013
By: MP

Boring No.: **Tailings Beach**
Sample: **1, 3, & 5**
Depth: **Surface**
Sample Description: Dark grey silty sand
Engineering Classification: Not requested
Sample type: Undisturbed-trimmed from thin-wall

	Test Number:	S1	S2	S3
Initial	Height, H (in)	4.776	4.907	4.797
	Diameter, D (in)	2.325	2.342	2.325
	Water content, w (%)	33.5	33.6	34.0
	Dry unit weight, γ_d (pcf)	109.1	106.6	109.3
	Saturation (%)	132.2	126.0	135.0
	Void ratio, e	0.79	0.83	0.79
	Mounting	Wet	Wet	Wet
Before shear	Water content, w (%)	23.6	24.2	22.4
	Dry unit weight, γ_d (pcf)	112.4	111.2	115.0
	Saturation[a] (%)	100.0	100.0	100.0
	Void ratio, e	0.74	0.76	0.70
	Area, A_{eoc} (in^2)	4.37	4.40	4.28
	Area method	A	A	A
	B	0.96	0.95	0.95
	t_{50} (min)	0.09	0.10	0.10
	Back pressure (psf)	7032	9791	5471
	Strain rate (%/min)	0.06	0.06	0.06
	Time to failure (min)	331.7	333.3	333.3
	Strain at failure, ε_f (%)	19.90	20.00	20.00
	Filter paper correction	No	No	No
	Membrane correction	Yes	Yes	Yes
Measured specific gravity	3.134			



[a] Saturation set to 100% for phase calculations

Summary of strength parameters at peak deviator stress		
Total stress	c (psf)	0
	ϕ (deg)	27.5
Effective stress	c' (psf)	0
	ϕ' (deg)	37.3

Comments:
Due to the initial low density of the soil, test specimens were extruded directly into a latex membrane, placed in the triaxial chamber, and a vacuum applied. Measurements for the unit weight were taken after the vacuum had been applied. The vacuum removed some of the initial water and densified the specimen. Due to this setup procedure the initial dry unit weight and saturation may be erroneously high.

Tested by:__________

Reviewed:__________

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Consolidated Undrained Triaxial Compression Test for Cohesive Soils

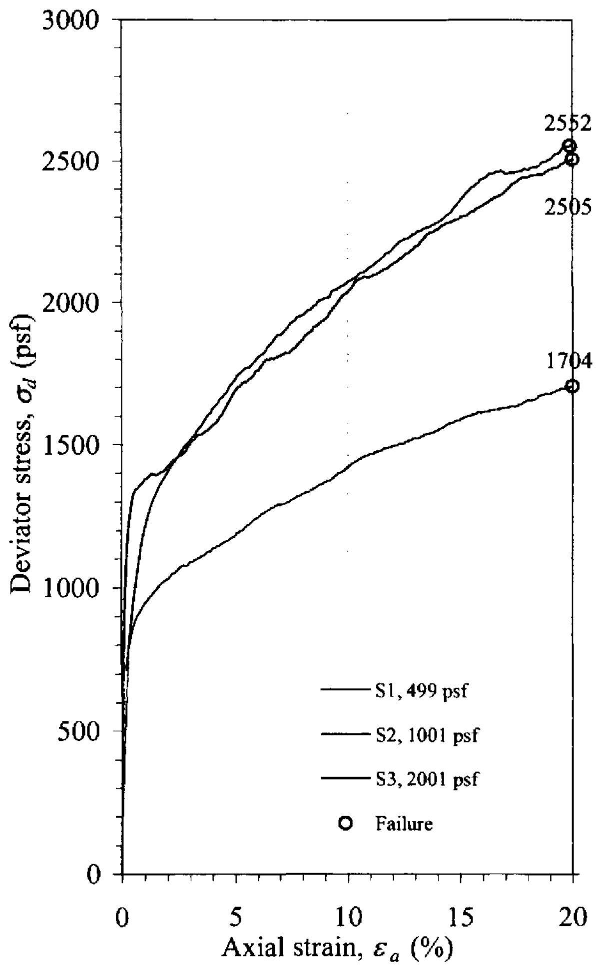
(*ASTM D4767*)

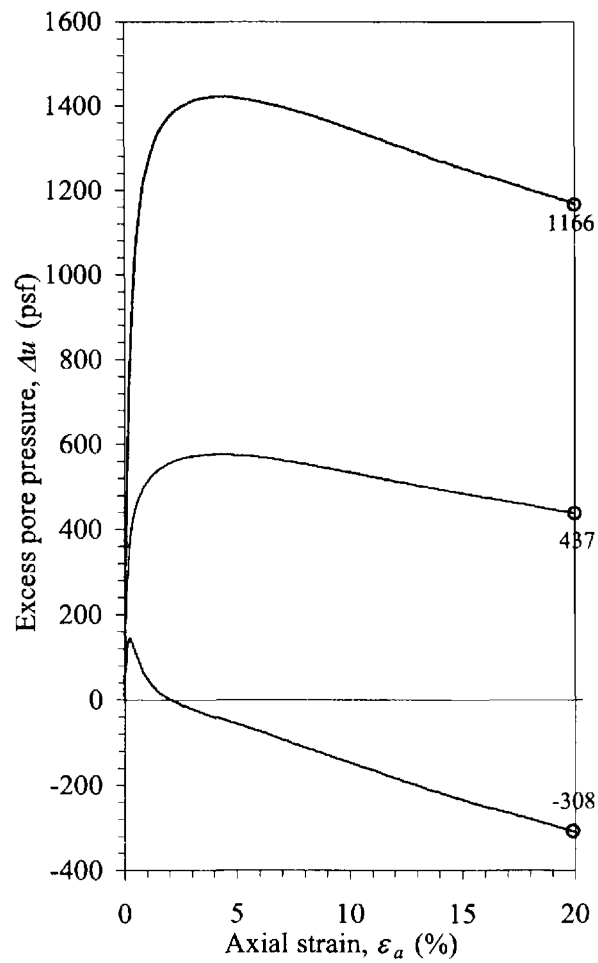
IGES

Project: CS Mining Existing Facility Expansion
No: 01640-001 (II)
Location: Milford, UT

Boring No.: Tailings Beach
Sample: 1, 3, & 5
Depth: Surface

	Test Number:	S1	S2	S3
Total stress	σ_3 (psf)	499	1001	2001
	σ_1-σ_3 (psf)	2552	1704	2505
	σ_1 (psf)	3051	2705	4506
	$q = (\sigma_1-\sigma_3)/2$ (psf)	1276	852	1253
	$p = (\sigma_1+\sigma_3)/2$ (psf)	1775	1853	3254
Effective stress	Δu (psf)	-308	437	1166
	σ'_3 (psf)	807	564	836
	σ'_1-σ'_3 (psf)	2552	1704	2505
	σ'_1 (psf)	3359	2268	3341
	$q = (\sigma'_1-\sigma'_3)/2$ (psf)	1276	852	1253
	$p' = (\sigma'_1+\sigma'_3)/2$ (psf)	2083	1416	2088
	σ'_1/σ'_3	4.16	4.02	4.00
	$A = \Delta u/(\sigma_1-\sigma_3)$	-0.121	0.256	0.465





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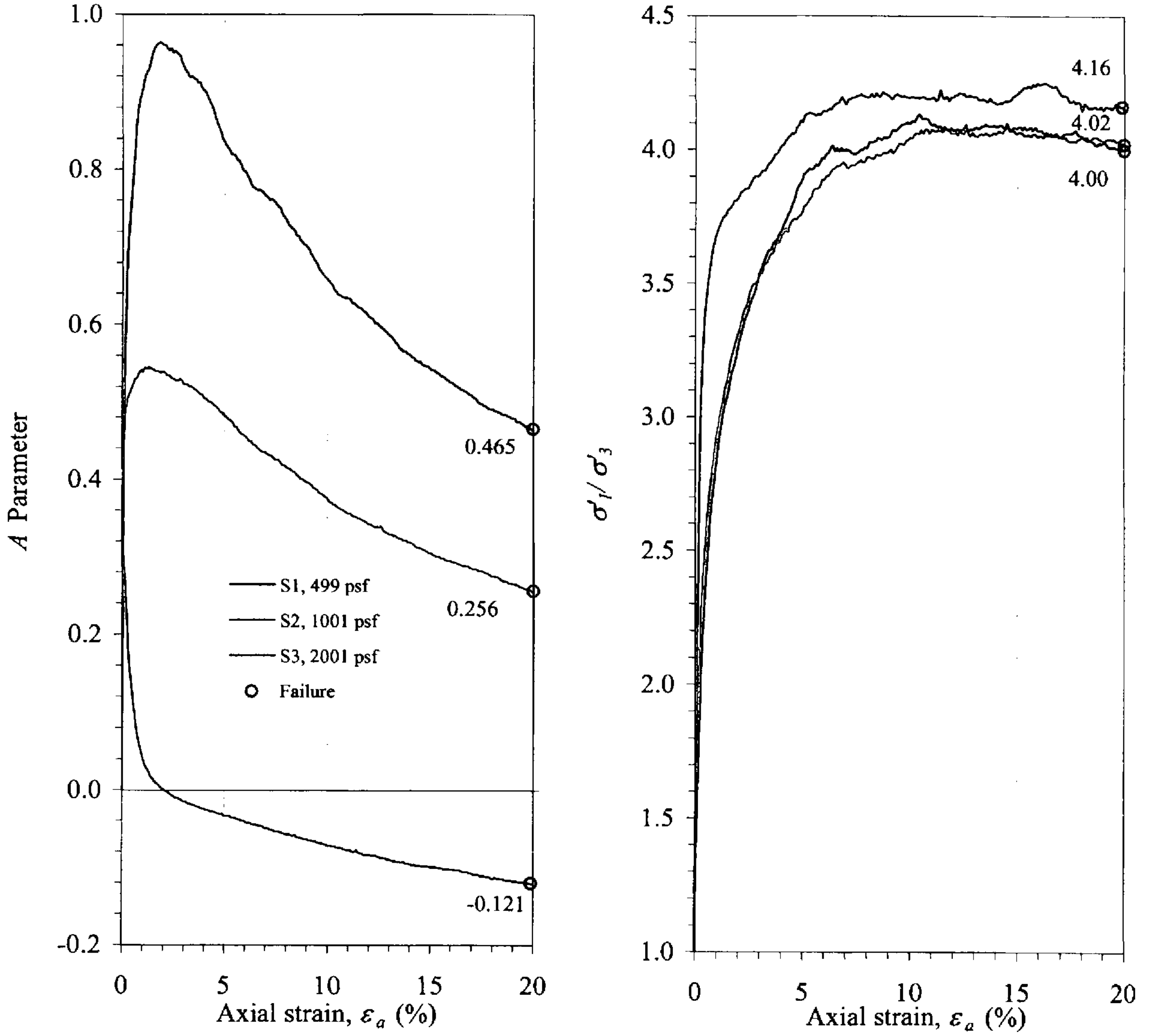
Consolidated Undrained Triaxial Compression Test for Cohesive Soils

(*ASTM D4767*)

Project: CS Mining Existing Facility Expansion
No: 01640-001 (II)
Location: Milford, UT

Boring No.: Tailings Beach
Sample: 1, 3, & 5
Depth: Surface

Summary of strength parameters at peak deviator stress		
Total stress	c (psf)	0
	ϕ (deg)	27.5
Effective stress	c' (psf)	0
	ϕ' (deg)	37.3



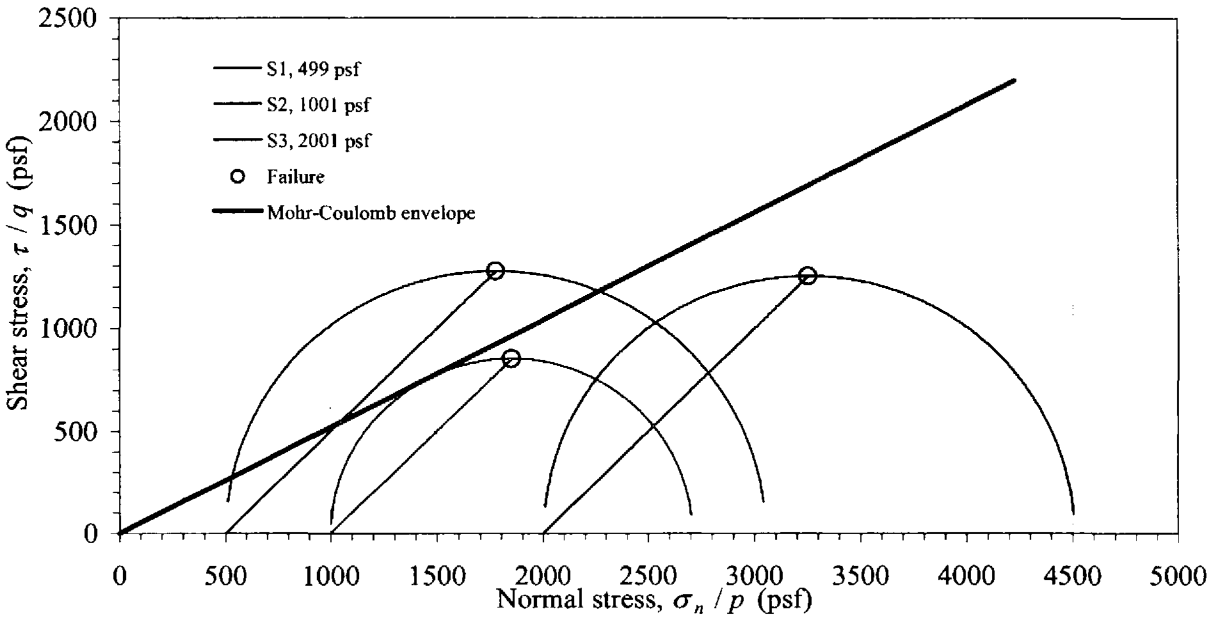
Z:\PROJECTS\01640_CS_mining\001_Tailings\II\[GTXCU3v2_TAILINGS_BEACH_5_SURFACE.xls]Summary

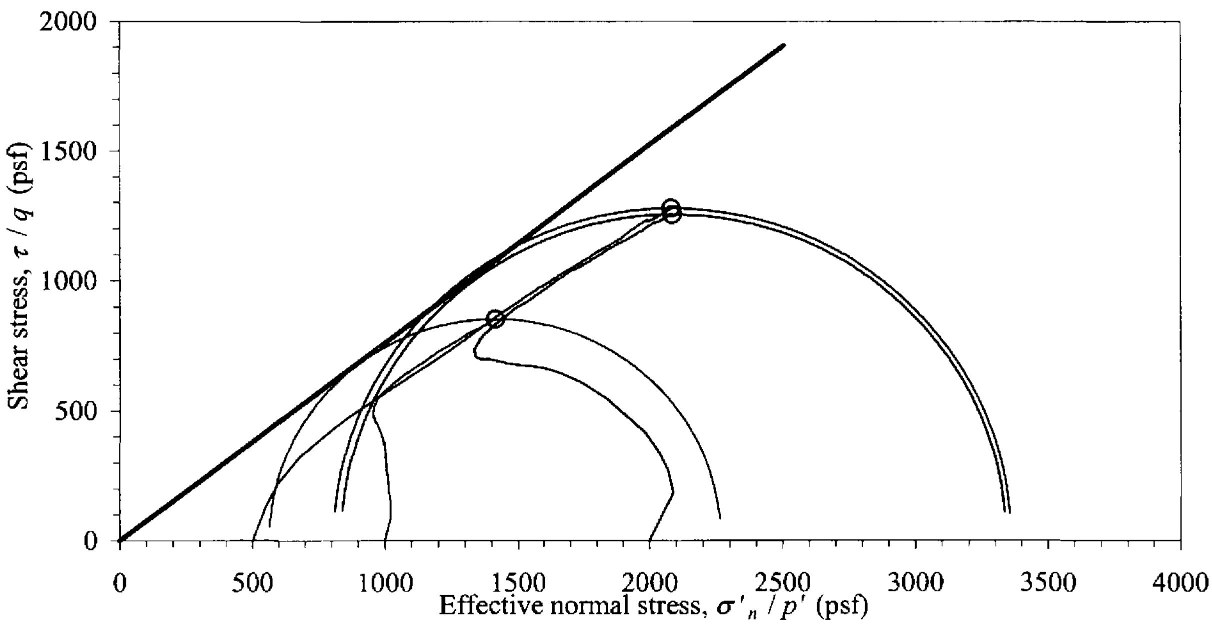
Consolidated Undrained Triaxial Compression Test for Cohesive Soils
(*ASTM D4767*)

Project: CS Mining Existing Facility Expansion
No: 01640-001 (II)
Location: Milford, UT

Boring No.: Tailings Beach
Sample: 1, 3, & 5
Depth: Surface

Summary of strength parameters at peak deviator stress		
Total stress	c (psf)	0
	ϕ (deg)	27.5
Effective stress	c' (psf)	0
	ϕ' (deg)	37.3





Z:\PROJECTS\01640_CS_mining\001_Tailings\II\[GTXCU3v2_TAILINGS_BEACH_5_SURFACE.xls]Summary

Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter, Method C (ASTM D5084)

IGES

Project: CS Mining Existing Facility Expansion
No: 01640-001 (II)
Location: Milford, UT
Date: 3/20/2013
By: JDF

Boring No.: TP-3
Sample:
Depth: 1-3'

Sample Description: Brown silty sand with gravel
Sample Type: Laboratory Compacted
Compaction Specifications: 95 (%) Dry unit weight at 12.3 (%) w

	Initial (o)	Final (f)
Sample Height, H (in)	3.010	3.001
Sample Diameter, D (in)	2.409	2.39
Sample Length, L (cm)	7.645	7.622
Sample Area, A (cm^2)	29.406	28.949
Sample Volume, V (cm^3)	224.82	220.64
Wt. Rings + Wet Soil (g)	491.1	500.21
Wt. Rings (g)	0	0
Wet Unit Wt., γ_m (pcf)	136.4	141.5
Wet Soil + Tare (g)	585.32	500.21
Dry Soil + Tare (g)	535.92	438.06
Tare (g)	127.9	0
Weight of solids, Ws (g)	438.06	438.06
Water Content, w (%)	12.11	14.19
Dry Unit Wt, γ_d (pcf)	121.6	123.9
Void ratio, e, for assumed Gs	0.36	0.38
Saturation (%), for assumed Gs	89.1	100 [a]
Average K[b] (cm/sec)	**2.3E-06**	

[a] Saturation set to 100% for phase calculations
[b] K corrected to 20°C

Optimum water content (%)	10.3	
Maximum dry unit weight (pcf)	127.5	
Gs	2.65	Assumed
Cell No.	1	
Station No.	1	
Permeant liquid used	De-aired tap water	
Total backpressure (psi)	34.5	
Effective horiz. consolidation stress (psi)	10.4	
Effective vert. consolidation stress (psi)	10.4	

	Initial (o)	Final (f)
B value	0.72	0.96
External Burette (cm^3)	9.30	20.20
Cell Pressure (psi)	0.0	44.9

Backpressure bottom (psi)	34.5
Backpressure top (psi)	34.5
System volume coefficient (cm^3/psi)	0.150
System volume change (cm^3)	6.72
Net sample volume change (cm^3)	-4.18
Bottom burette ground length, l_b (cm)	82.00
Top burette ground length, l_t (cm)	82.1
Burette area, a (cm^2)	0.197
Conversion, reading to cm head (cm/rd)	5.076

Start Date and Time: 3/18/13 12:58

Elapsed time (sec)	Bottom Burette (cm^3)	Top Burette (cm^3)	h_1 (cm)	h_2 (cm)	K (cm/sec)	Temp (°C)	Visc. Ratio R_f	K[b] (cm/sec)
4620.0	3.22 3.84	6.82 6.18	18.17	11.78	2.4E-06	21.3	0.97	2.4E-06
6240.0	0.00 2.20	10.00 7.78	50.66	28.22	2.4E-06	22.5	0.94	2.3E-06
4800.0	0.00 1.80	10.00 8.20	50.66	32.39	2.4E-06	19.7	1.01	2.4E-06
3480.0	1.80 2.62	8.20 7.38	32.39	24.06	2.2E-06	19.7	1.01	2.2E-06
4440.0	2.62 3.36	7.38 6.64	24.06	16.55	2.2E-06	19.4	1.02	2.2E-06

Entered by:___________
Reviewed:___________

Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter, Method C (ASTM D5084)

IGES

Project: CS Mining Exisiting Facility Expansion
No: 01640-001 (II)
Location: Milford, UT
Date: 3/19/2013
By: MP

Boring No.: TP-6
Sample:
Depth: 2-3, 5-6'

Sample Description: Brown silty sand
Sample Type: Laboratory Compacted
Compaction Specifications: 95 (%) Dry unit weight at 16.5 (%) w

	Initial (o)	Final (f)
Sample Height, H (in)	3.009	3.001
Sample Diameter, D (in)	2.407	2.39
Sample Length, L (cm)	7.643	7.623
Sample Area, A (cm^2)	29.357	28.971
Sample Volume, V (cm^3)	224.37	220.85
Wt. Rings + Wet Soil (g)	458.95	471.816
Wt. Rings (g)	0	0
Wet Unit Wt., γ_m (pcf)	127.7	133.4
Wet Soil + Tare (g)	494	598.57
Dry Soil + Tare (g)	441.55	520.28
Tare (g)	124.47	125.05
Weight of solids, Ws (g)	393.81	393.81
Water Content, w (%)	16.54	19.81
Dry Unit Wt, γ_d (pcf)	109.6	111.3
Void ratio, e, for assumed Gs	0.51	0.52
Saturation (%), for assumed Gs	86.0	100 [a]
Average K[b] (cm/sec)	**5.9E-05**	

[a] Saturation set to 100% for phase calculations
[b] K corrected to 20°C

Optimum water content (%)	14.5	
Maximum dry unit weight (pcf)	115.5	
Gs	2.65	Assumed
Cell No.	2	
Station No.	2	
Permeant liquid used	De-aired tap water	
Total backpressure (psi)	34.5	
Effective horiz. consolidation stress (psi)	10.4	
Effective vert. consolidation stress (psi)	10.4	

	Initial (o)	Final (f)
B value	0.54	1.00
External Burette (cm^3)	8.50	19.10
Cell Pressure (psi)	0.0	44.9

Backpressure bottom (psi)	34.5
Backpressure top (psi)	34.5
System volume coefficient (cm^3/psi)	0.158
System volume change (cm^3)	7.08
Net sample volume change (cm^3)	-3.52
Bottom burette ground length, l_b (cm)	81.99
Top burette ground length, l_t (cm)	81.97
Burette area, a (cm^2)	0.197
Conversion, reading to cm head (cm/rd)	5.076

Start Date and Time: 3/18/13 13:00

Elapsed time (sec)	Bottom Burette (cm^3)	Top Burette (cm^3)	h_1 (cm)	h_2 (cm)	K (cm/sec)	Temp (°C)	Visc. Ratic R_f	K[b] (cm/sec)
420.0	0.08 3.26	9.94 6.74	50.07	17.68	6.4E-05	22.1	0.95	6.1E-05
420.0	0.00 3.20	10.00 6.76	50.78	18.09	6.4E-05	22.1	0.95	6.1E-05
420.0	0.00 3.18	10.00 6.78	50.78	18.29	6.3E-05	22.1	0.95	6.0E-05
420.0	0.00 3.14	10.00 6.82	50.78	18.70	6.2E-05	22.1	0.95	5.9E-05
420.0	0.00 3.10	9.94 6.84	50.48	19.00	6.0E-05	22.1	0.95	5.7E-05

Entered by:__________
Reviewed:__________

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Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis

(ASTM D6913)

IGES

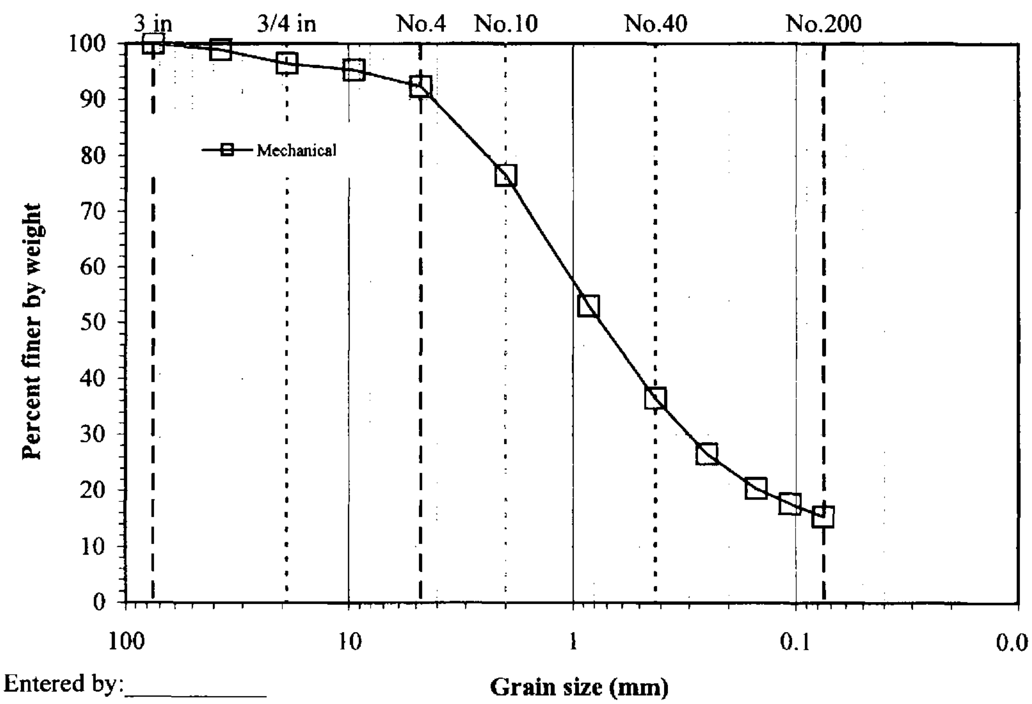
Project: CS Mining SW Facility Development
No: 01640-002
Location: Milford, UT
Date: 3/20/2013
By: BRR

Boring No.: TP-2
Sample:
Depth: 2-3'
Description: Brown clayey sand

Split:	Yes	
Split sieve:	3/8"	
	Moist	Dry
Total sample wt. (g):	19819.75	18930.7
+3/8" Coarse fraction (g):	897.95	886.1
-3/8" Split fraction (g):	1245.89	1188.13
Split fraction:	0.953	

Water content data	C.F.(+3/8")	S.F.(-3/8")
Moist soil + tare (g):	1113.34	1558.07
Dry soil + tare (g):	1101.49	1500.31
Tare (g):	215.38	312.18
Water content (%):	1.3	4.9

Sieve	Accum. Wt. Ret. (g)	Grain Size (mm)	Percent Finer	
8"	-	200	-	
6"	-	150	-	
4"	-	100	-	
3"	-	75	100.0	
1.5"	209.79	37.5	98.9	
3/4"	689.19	19	96.4	
3/8"	886.10	9.5	95.3	←Split
No.4	37.76	4.75	92.3	
No.10	234.80	2	76.5	
No.20	528.40	0.85	52.9	
No.40	732.87	0.425	36.5	
No.60	857.50	0.25	26.5	
No.100	934.51	0.15	20.3	
No.140	968.82	0.106	17.6	
No.200	996.42	0.075	15.4	



Gravel (%): 7.7
Sand (%): 76.9
Fines (%): 15.4

Entered by:__________
Reviewed:__________

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Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis

(ASTM D6913)

IGES

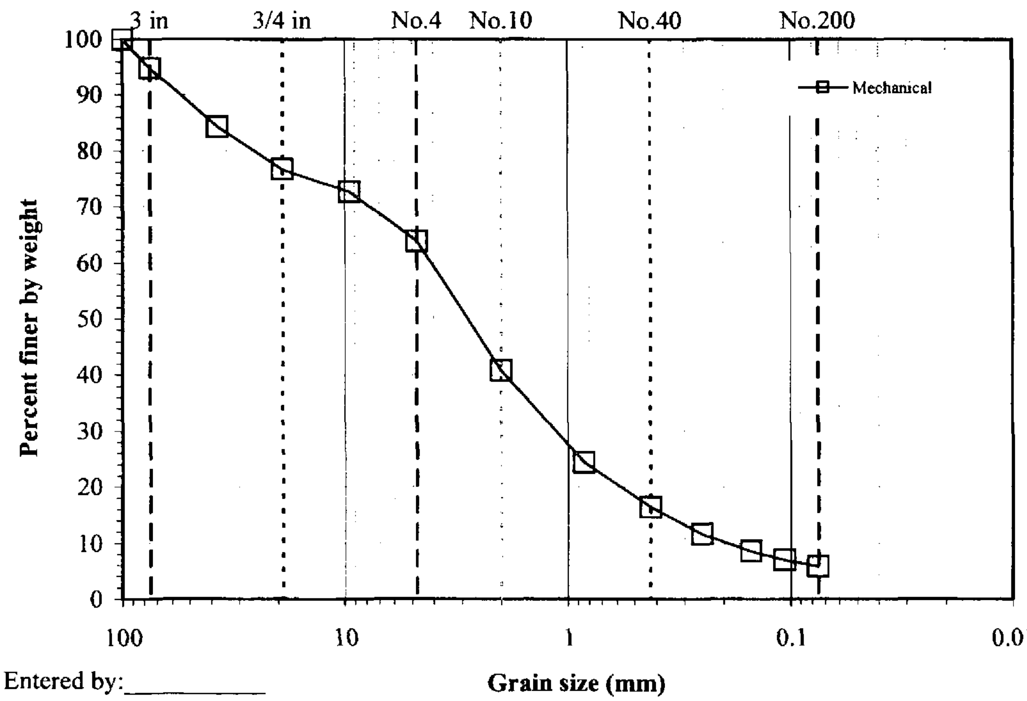
Project: CS Mining SW Facility Development
No: 01640-002
Location: Milford, UT
Date: 3/20/2013
By: BRR

Boring No.: TP-2
Sample:
Depth: 7-8'
Description: Brown sand with silt and gravel

Split:	Yes	
Split sieve:	3/4"	
	Moist	Dry
Total sample wt. (g):	25416.80	24755.1
+3/4" Coarse fraction (g):	5849	5771.1
-3/4" Split fraction (g):	1677.23	1627.19
Split fraction:	0.767	

Water content data	C.F.(+3/4")	S.F.(-3/4")
Moist soil + tare (g):	1234.68	2086.26
Dry soil + tare (g):	1222.37	2036.22
Tare (g):	310.62	409.03
Water content (%):	1.4	3.1

Sieve	Accum. Wt. Ret. (g)	Grain Size (mm)	Percent Finer	
8"	-	200	-	
6"	-	150	-	
4"	-	100	100.0	
3"	1303.20	75	94.7	
1.5"	3897.68	37.5	84.3	
3/4"	5771.08	19	76.7	←Split
3/8"	86.83	9.5	72.6	
No.4	274.56	4.75	63.7	
No.10	760.55	2	40.8	
No.20	1109.11	0.85	24.4	
No.40	1278.13	0.425	16.5	
No.60	1382.18	0.25	11.5	
No.100	1445.79	0.15	8.5	
No.140	1477.60	0.106	7.0	
No.200	1503.72	0.075	5.8	



Gravel (%): 36.3
Sand (%): 57.9
Fines (%): 5.8

Entered by:__________
Reviewed:__________

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Laboratory Compaction Characteristics of Soil

(ASTM D698 / D1557)

IGES

Project: CS Mining SW Facility Development
No: 01640-002
Location: Milford, UT
Date: 3/18/2013
By: BRR

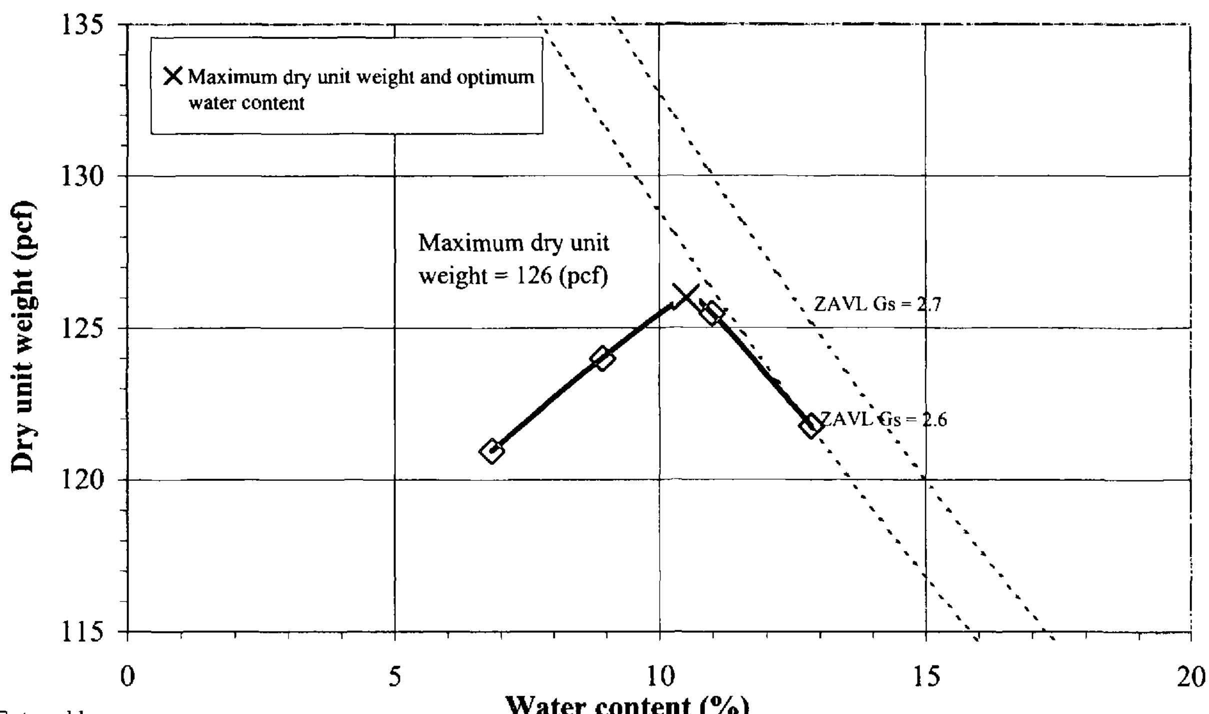
Boring No.: TP-2
Sample:
Depth: 2-3'
Sample Description: Brown clayey sand
Engineering Classification: Not requested
As-received water content (%): Not requested

Method: ASTM D698 B
Mold Id. Inc 2
Mold volume (ft^3): 0.0332

Preparation method: Moist
Rammer: Mechanical-circular face
Rock Correction: No

Optimum water content (%): 10.5
Maximum dry unit weight (pcf): 126

Point Number	+4%	+6%	+8%	+2%				
Wt. Sample + Mold (g)	6198.1	6261.6	6233.4	6109.8				
Wt. of Mold (g)	4163.1	4163.1	4163.1	4163.1				
Wet Unit Wt., γ_m (pcf)	135.0	139.3	137.4	129.2				
Wet Soil + Tare (g)	793.37	801.81	856.30	770.42				
Dry Soil + Tare (g)	738.55	735.20	772.92	729.46				
Tare (g)	124.08	128.47	123.37	128.78				
Water Content, w (%)	**8.9**	**11.0**	**12.8**	**6.8**				
Dry Unit Wt., γ_d (pcf)	**124.0**	**125.5**	**121.8**	**120.9**				



Entered by:__________
Reviewed:__________

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Laboratory Compaction Characteristics of Soil

(ASTM D698 / D1557)

Project: CS Mining SW Facility Development
No: 01640-002
Location: Milford, UT
Date: 3/18/2013
By: BRR

Boring No.: TP-2
Sample:
Depth: 7-8'
Sample Description: Brown sand with silt and gravel
Engineering Classification: Not requested
As-received water content (%): Not requested

Method: ASTM D698 C
Mold Id. Inc 4
Mold volume (ft^3): 0.0751

Preparation method: Moist
Rammer: Mechanical-sector face
Rock Correction: Yes * See results below
Percent fraction retained, Pc (%) 23.3
Percent fraction passing, Pf (%) 76.7

Optimum water content (%): 11.2
Maximum dry unit weight (pcf): 123.7

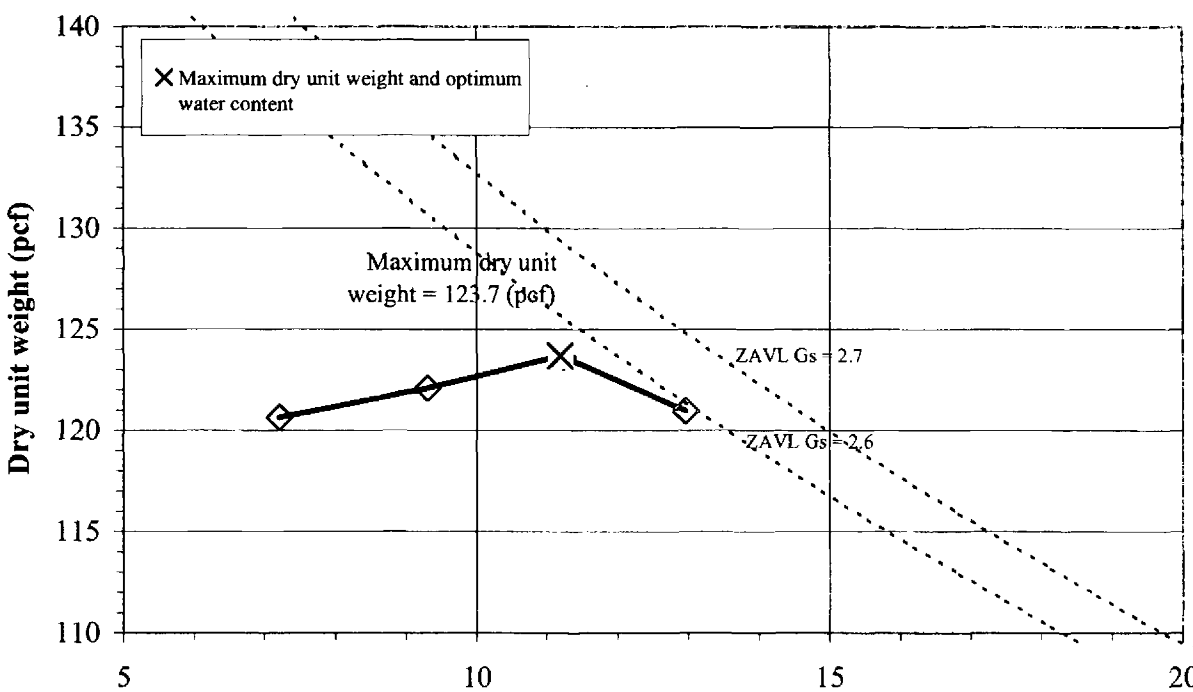
Point Number	+6%	+8%	+2%	+10%				
Wt. Sample + Mold (g)	10149.9	10289.7	10011.1	10260.0				
Wt. of Mold (g)	5603.7	5603.7	5603.7	5603.7				
Wet Unit Wt., γ_m (pcf)	133.4	137.5	129.4	136.7				
Wet Soil + Tare (g)	1111.53	1388.96	1232.87	1525.45				
Dry Soil + Tare (g)	1043.39	1280.52	1170.99	1404.10				
Tare (g)	310.58	315.02	312.96	467.94				
Water Content, w (%)	**9.3**	**11.2**	**7.2**	**13.0**				
Dry Unit Wt., γ_d (pcf)	**122.1**	**123.7**	**120.7**	**121.0**				

*Correction of Unit Weight and Water Content for Soils Containing Oversize Particles

(ASTM D4718)

Corrected water content (%): 8.9
Corrected dry unit weight (pcf): 131.4

Oversized fraction, +3/4-in. (%): 23.3
Water content, +3/4-in. (%): 1.4
Sieve for oversized fraction: 3/4-in.
Bulk specific gravity, Gs: 2.65 Assumed



Entered by:__________
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Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter, Method C (ASTM D5084)

IGES

Project: CS Mining SW Facility Development
No: 01640-002
Location: Milford, UT
Date: 3/26/2013
By: JDF

Boring No.: TP-2
Sample:
Depth: 2-3'
Sample Description: Brown clayey sand
Sample Type: Laboratory Compacted
Compaction Specifications: 95 (%) Dry unit weight at 12.5 (%) w

	Initial (o)	Final (f)
Sample Height, H (in)	3.008	2.999
Sample Diameter, D (in)	2.399	2.38
Sample Length, L (cm)	7.640	7.617
Sample Area, A (cm^2)	29.162	28.716
Sample Volume, V (cm^3)	222.81	218.73
Wt. Rings + Wet Soil (g)	479.93	490.48
Wt. Rings (g)	0	0
Wet Unit Wt., γ_m (pcf)	134.5	140.0
Wet Soil + Tare (g)	286.47	613.55
Dry Soil + Tare (g)	268.97	549.85
Tare (g)	128.29	122.64
Weight of solids, Ws (g)	426.83	426.83
Water Content, w (%)	12.44	14.91
Dry Unit Wt, γ_d (pcf)	119.6	121.8
Void ratio, e, for assumed Gs	0.38	0.40
Saturation (%), for assumed Gs	86.0	100 [a]
Average K[b] (cm/sec)	**2.6E-04**	

[a] Saturation set to 100% for phase calculations
[b] K corrected to 20°C

Optimum water content (%)	10.5	
Maximum dry unit weight (pcf)	126	
Gs	2.65	Assumed
Cell No.	2	
Station No.	2	
Permeant liquid used	De-aired tap water	
Total backpressure (psi)	34.5	
Effective horiz. consolidation stress (psi)	13.9	
Effective vert. consolidation stress (psi)	13.9	

	Initial (o)	Final (f)
B value	0.82	0.98
External Burette (cm^3)	17.60	29.30
Cell Pressure (psi)	0.0	48.4

Backpressure bottom (psi)	34.5
Backpressure top (psi)	34.5
System volume coefficient (cm^3/psi)	0.158
System volume change (cm^3)	7.63
Net sample volume change (cm^3)	-4.07
Bottom burette ground length, l_b (cm)	81.99
Top burette ground length, l_t (cm)	81.97
Burette area, a (cm^2)	0.197
Conversion, reading to cm head (cm/rd)	5.076

Start Date and Time: 3/25/13 8:16

Elapsed time (sec)	Bottom Burette (cm^3)	Top Burette (cm^3)	h_1 (cm)	h_2 (cm)	K (cm/sec)	Temp (°C)	Visc. Ratio R_f	K[b] (cm/sec)
90.0	0.00 3.04	10.00 6.96	50.78	19.92	2.7E-04	21.6	0.96	2.6E-04
90.0	0.00 3.02	10.00 6.98	50.78	20.12	2.7E-04	21.6	0.96	2.6E-04
90.0	0.00 2.96	10.00 7.04	50.78	20.73	2.6E-04	21.6	0.96	2.5E-04
90.0	0.00 3.00	10.00 7.00	50.78	20.32	2.7E-04	21.6	0.96	2.6E-04

Entered by:__________
Reviewed:__________

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Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter, Method C (ASTM D5084)

IGES

Project: CS Mining SW Facility Development
No: 01640-002
Location: Milford, UT
Date: 3/26/2013
By: JDF

Boring No.: TP-2
Sample:
Depth: 7-8'

Sample Description: Brown sand with silt
Sample Type: Laboratory Compacted
Compaction Specifications: 95 (%) Dry unit weight at 13.2 (%) w

	Initial (o)	Final (f)
Sample Height, H (in)	3.002	2.994
Sample Diameter, D (in)	2.403	2.39
Sample Length, L (cm)	7.625	7.605
Sample Area, A (cm^2)	29.259	28.870
Sample Volume, V (cm^3)	223.10	219.55
Wt. Rings + Wet Soil (g)	474.51	482.41
Wt. Rings (g)	0	0
Wet Unit Wt., γ_m (pcf)	132.8	137.2
Wet Soil + Tare (g)	357.98	607.99
Dry Soil + Tare (g)	331.24	544.37
Tare (g)	128.08	121.53
Weight of solids, Ws (g)	419.32	419.32
Water Content, w (%)	13.16	15.05
Dry Unit Wt, γ_d (pcf)	117.3	119.2
Void ratio, e, for assumed Gs	0.41	0.40
Saturation (%), for assumed Gs	85.1	100 [a]
Average K[b] (cm/sec)	**4.1E-04**	

[a] Saturation set to 100% for phase calculations
[b] K corrected to 20°C

Optimum water content (%)	11.2	
Maximum dry unit weight (pcf)	123.7	
Gs	2.65	Assumed
Cell No.	1	
Station No.	1	
Permeant liquid used	De-aired tap water	
Total backpressure (psi)	34.5	
Effective horiz. consolidation stress (psi)	13.9	
Effective vert. consolidation stress (psi)	13.9	

	Initial (o)	Final (f)
B value	0.72	0.98
External Burette (cm^3)	19.50	30.30
Cell Pressure (psi)	0.0	48.4

Backpressure bottom (psi)	34.5
Backpressure top (psi)	34.5
System volume coefficient (cm^3/psi)	0.150
System volume change (cm^3)	7.25
Net sample volume change (cm^3)	-3.55
Bottom burette ground length, l_b (cm)	82.00
Top burette ground length, l_t (cm)	82.1
Burette area, a (cm^2)	0.197
Conversion, reading to cm head (cm/rd)	5.076

Start Date and Time: 3/25/13 8:14

Elapsed time (sec)	Bottom Burette (cm^3)	Top Burette (cm^3)	h_1 (cm)	h_2 (cm)	K (cm/sec)	Temp (°C)	Visc. Ratic R_f	K^b (cm/sec)
45.0	0.00 2.62	10.00 7.38	50.66	24.06	4.3E-04	21.2	0.97	4.2E-04
45.0	0.00 2.62	10.00 7.38	50.66	24.06	4.3E-04	21.2	0.97	4.2E-04
45.0	0.00 2.60	10.00 7.40	50.66	24.27	4.2E-04	21.2	0.97	4.1E-04
45.0	0.00 2.60	10.00 7.40	50.66	24.27	4.2E-04	21.2	0.97	4.1E-04

Entered by:___________
Reviewed:___________

Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis

(ASTM D6913)

IGES

Project: CS Mining - SW Pond
No: 01640-002 (II)
Location: Milford, UT
Date: 4/12/2013
By: JG

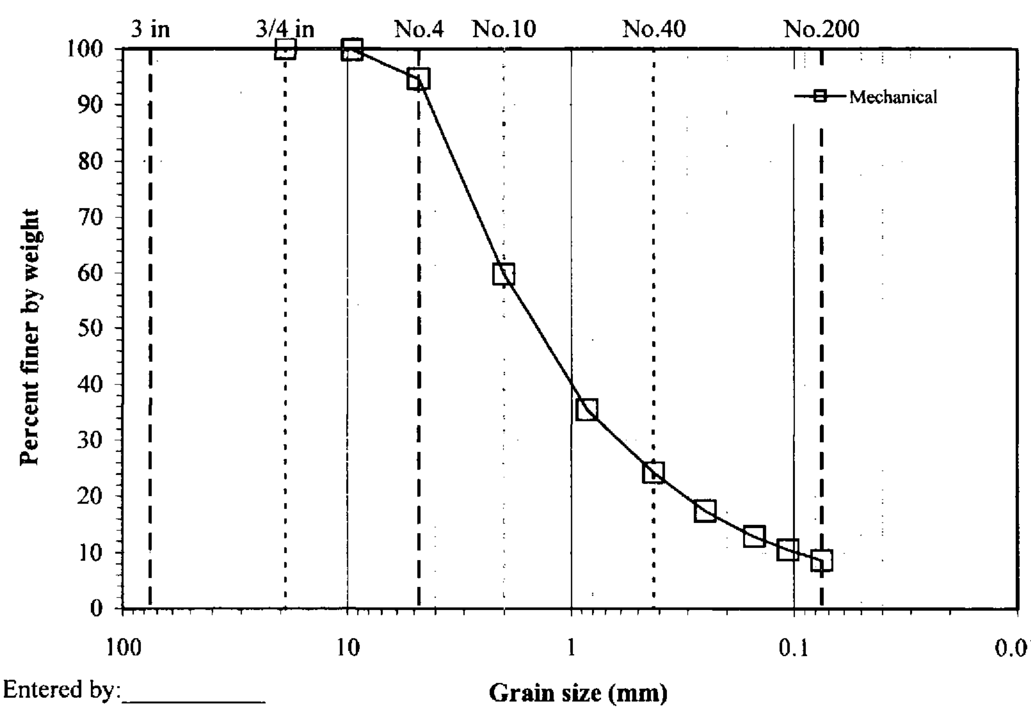
Boring No.: TP-21
Sample:
Depth: 4.5-5'
Description: Light brown sand with silt

Split:	No	
	-	
	Moist	Dry
Total sample wt. (g):	670.70	645.5
Split fraction:	1.000	

Water content data

Moist soil + tare (g):	-	889.86
Dry soil + tare (g):	-	864.63
Tare (g):	-	219.16
Water content (%):	0.0	3.9

Sieve	Accum. Wt. Ret. (g)	Grain Size (mm)	Percent Finer
8"	-	200	-
6"	-	150	-
4"	-	100	-
3"	-	75	-
1.5"	-	37.5	-
3/4"	-	19	100.0
3/8"	1.61	9.5	99.8
No.4	34.32	4.75	94.7
No.10	259.64	2	59.8
No.20	416.89	0.85	35.4
No.40	489.53	0.425	24.2
No.60	533.33	0.25	17.4
No.100	561.99	0.15	12.9
No.140	577.70	0.106	10.5
No.200	589.76	0.075	8.6



Gravel (%): 5.3
Sand (%): 86.1
Fines (%): 8.6

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Reviewed:___________

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Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis

(ASTM D6913)

IGES

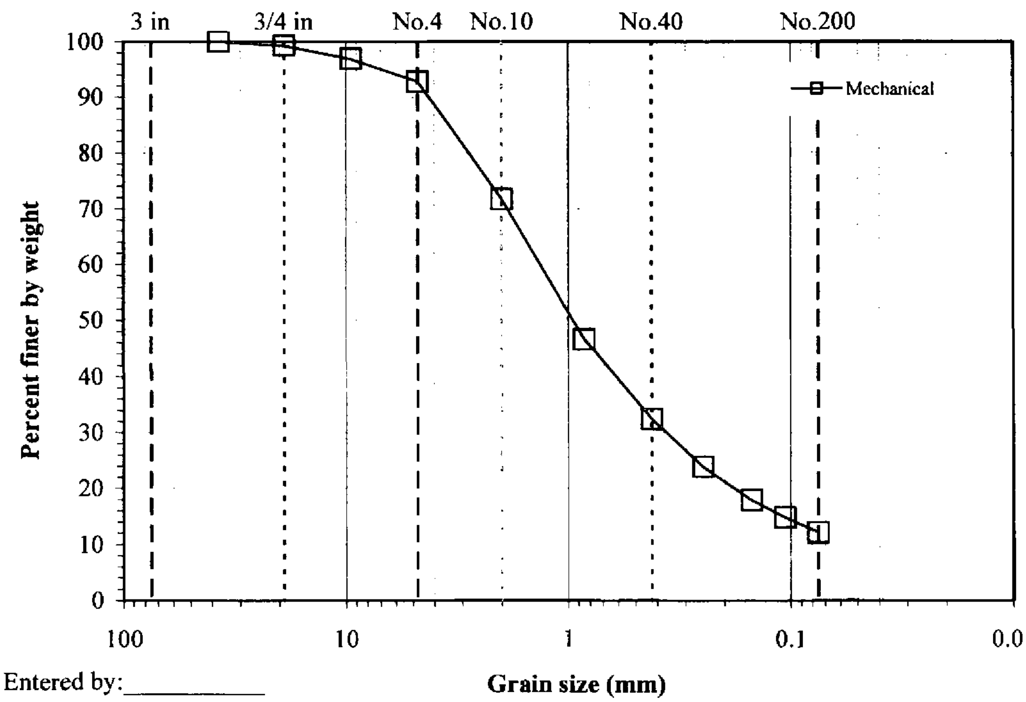
Project: CS Mining - SW Pond
No: 01640-002 (II)
Location: Milford, UT
Date: 4/11/2013
By: DKS

Boring No.: TP-24
Sample:
Depth: 3-4'
Description: Brown silty sand

Split:	Yes	
Split sieve:	3/8"	
	Moist	Dry
Total sample wt. (g):	27676.00	26013.1
+3/8" Coarse fraction (g):	841.7	812.6
-3/8" Split fraction (g):	943.46	886.02
Split fraction:	0.969	

Water content data	C.F.(+3/8")	S.F.(-3/8")
Moist soil + tare (g):	778.86	1390.05
Dry soil + tare (g):	759.69	1332.61
Tare (g):	225.10	446.59
Water content (%):	3.6	6.5

Sieve	Accum. Wt. Ret. (g)	Grain Size (mm)	Percent Finer	
8"	-	200	-	
6"	-	150	-	
4"	-	100	-	
3"	-	75	-	
1.5"	-	37.5	100.0	
3/4"	190.47	19	99.3	
3/8"	812.56	9.5	96.9	←Split
No.4	37.66	4.75	92.8	
No.10	231.04	2	71.6	
No.20	459.89	0.85	46.6	
No.40	589.41	0.425	32.4	
No.60	668.07	0.25	23.8	
No.100	722.36	0.15	17.9	
No.140	751.16	0.106	14.7	
No.200	774.33	0.075	12.2	



Gravel (%): 7.2
Sand (%): 80.5
Fines (%): 12.2

Entered by:__________
Reviewed:__________

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Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis

(ASTM D6913)

IGES

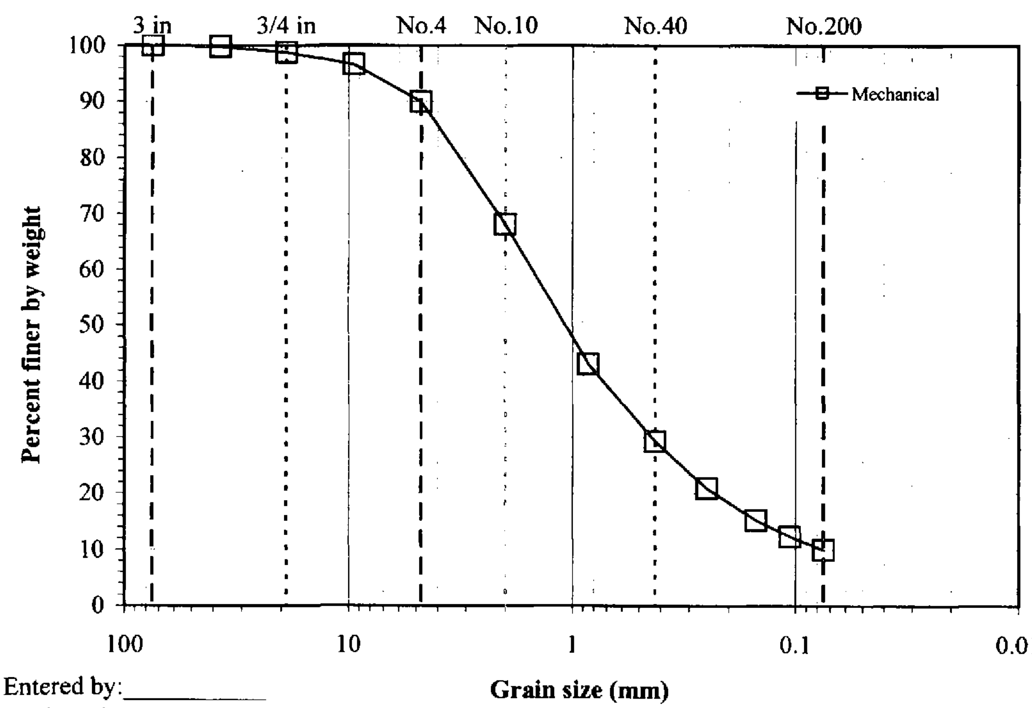
Project: CS Mining - SW Pond
No: 01640-002 (II)
Location: Milford, UT
Date: 4/18/2013
By: BRR

Boring No.: TP-24
Sample:
Depth: 5-6'
Description: Brown sand

Split:	Yes	
Split sieve:	3/8"	
	Moist	Dry
Total sample wt. (g):	29787.89	28430.5
+3/8" Coarse fraction (g):	1020.49	979.5
-3/8" Split fraction (g):	1328.17	1267.39
Split fraction:	0.966	

Water content data	C.F.(+3/8")	S.F.(-3/8")
Moist soil + tare (g):	1242.44	1737.99
Dry soil + tare (g):	1201.47	1677.21
Tare (g):	221.95	409.82
Water content (%):	4.2	4.8

Sieve	Accum. Wt. Ret. (g)	Grain Size (mm)	Percent Finer	
8"	-	200	-	
6"	-	150	-	
4"	-	100	-	
3"	-	75	100.0	
1.5"	66.39	37.5	99.8	
3/4"	341.61	19	98.8	
3/8"	979.51	9.5	96.6	←Split
No.4	87.46	4.75	89.9	
No.10	372.48	2	68.2	
No.20	702.27	0.85	43.1	
No.40	883.02	0.425	29.3	
No.60	992.79	0.25	20.9	
No.100	1066.88	0.15	15.3	
No.140	1105.65	0.106	12.3	
No.200	1136.49	0.075	10.0	



Gravel (%): 10.1
Sand (%): 79.9
Fines (%): 10.0

Entered by:__________
Reviewed:__________

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Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis

(ASTM D6913)

IGES

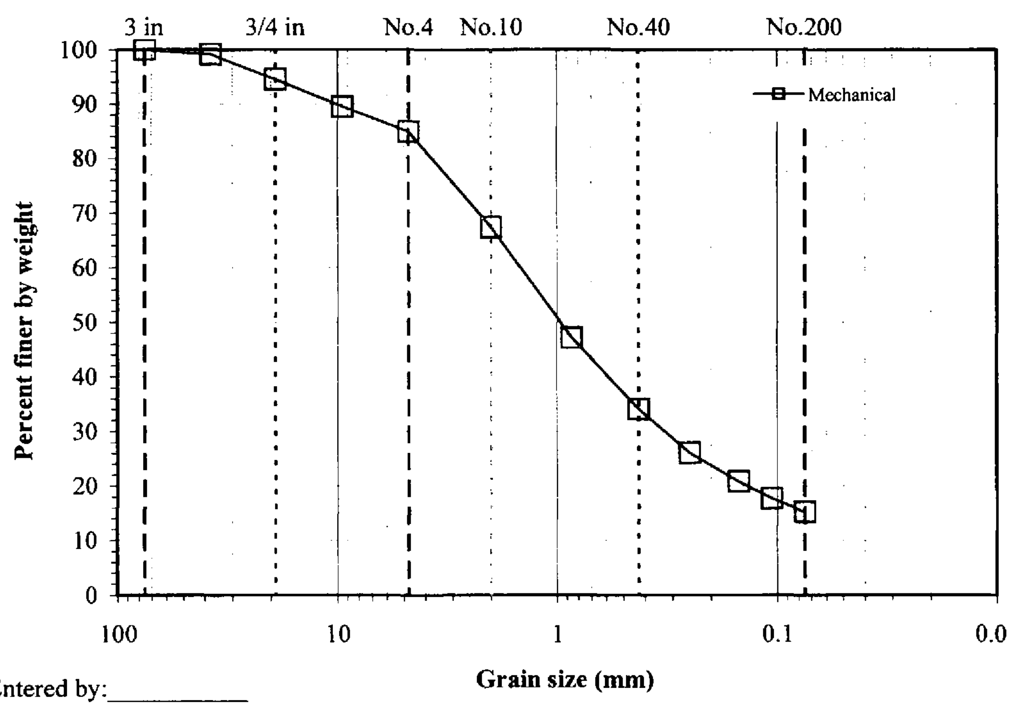
Project: CS Mining - SW Pond
No: 01640-002 (II)
Location: Milford, UT
Date: 4/12/2013
By: JG

Boring No.: TP-25
Sample:
Depth: 2-3'
Description: Brown silty sand with gravel

Split:	Yes	
Split sieve:	3/8"	
	Moist	Dry
Total sample wt. (g):	25868.10	23559.6
+3/8" Coarse fraction (g):	2622.2	2498.5
-3/8" Split fraction (g):	804.72	729.09
Split fraction:	0.894	

Water content data	C.F.(+3/8")	S.F.(-3/8")
Moist soil + tare (g):	2932.41	1115.50
Dry soil + tare (g):	2808.70	1039.87
Tare (g):	310.67	310.78
Water content (%):	5.0	10.4

Sieve	Accum. Wt. Ret. (g)	Grain Size (mm)	Percent Finer	
8"	-	200	-	
6"	-	150	-	
4"	-	100	-	
3"	-	75	100.0	
1.5"	221.24	37.5	99.1	
3/4"	1294.11	19	94.5	
3/8"	2498.47	9.5	89.4	←Split
No.4	37.67	4.75	84.8	
No.10	180.47	2	67.3	
No.20	345.01	0.85	47.1	
No.40	451.43	0.425	34.0	
No.60	516.56	0.25	26.1	
No.100	559.97	0.15	20.7	
No.140	585.09	0.106	17.7	
No.200	605.53	0.075	15.1	



Gravel (%): 15.2
Sand (%): 69.6
Fines (%): 15.1

Entered by:__________
Reviewed:__________

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Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis

(ASTM D6913)

IGES

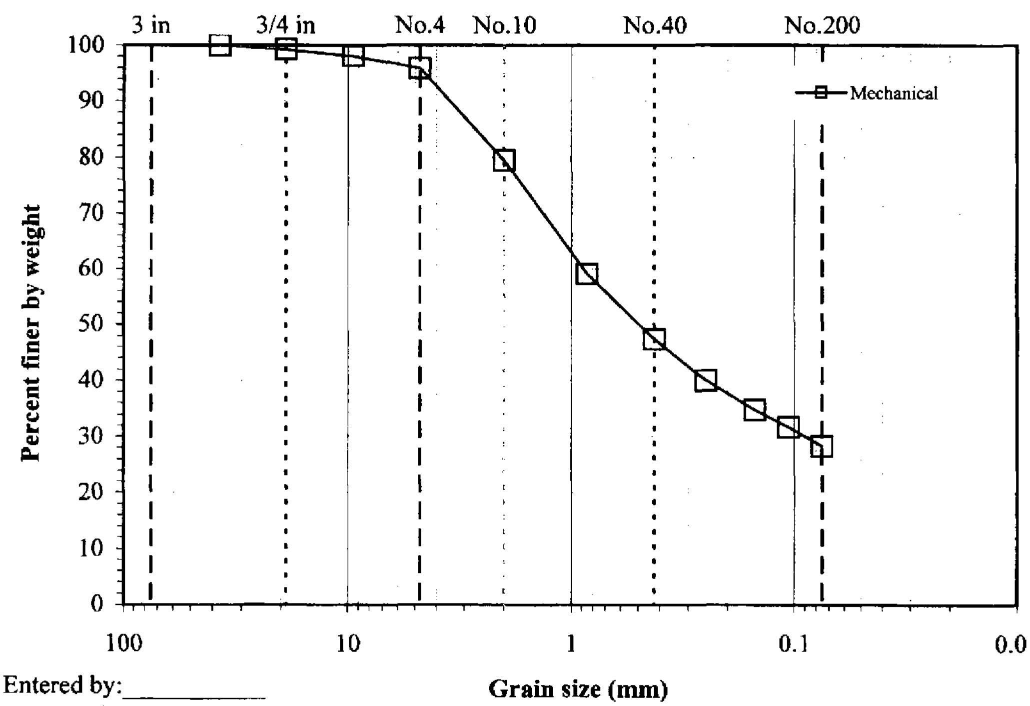
Project: CS Mining - SW Pond
No: 01640-002 (II)
Location: Milford, UT
Date: 4/18/2013
By: BRR

Boring No.: TP-26
Sample:
Depth: 2-3'
Description: Brown silty sand

Split:	Yes	
Split sieve:	3/8"	
	Moist	Dry
Total sample wt. (g):	26085.73	24537.5
+3/8" Coarse fraction (g):	486.33	477.7
-3/8" Split fraction (g):	1340.18	1259.58
Split fraction:	0.981	

Water content data	C.F.(+3/8")	S.F.(-3/8")
Moist soil + tare (g):	613.15	1749.26
Dry soil + tare (g):	604.54	1668.66
Tare (g):	126.80	409.08
Water content (%):	1.8	6.4

Sieve	Accum. Wt. Ret. (g)	Grain Size (mm)	Percent Finer	
8"	-	200	-	
6"	-	150	-	
4"	-	100	-	
3"	-	75	-	
1.5"	-	37.5	100.0	
3/4"	183.87	19	99.3	
3/8"	477.72	9.5	98.1	←Split
No.4	28.40	4.75	95.8	
No.10	239.24	2	79.4	
No.20	501.12	0.85	59.0	
No.40	652.00	0.425	47.3	
No.60	745.86	0.25	40.0	
No.100	813.10	0.15	34.8	
No.140	853.11	0.106	31.6	
No.200	896.99	0.075	28.2	



Gravel (%): 4.2
Sand (%): 67.6
Fines (%): 28.2

Entered by:__________
Reviewed:__________

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Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis

(ASTM D6913)

IGES

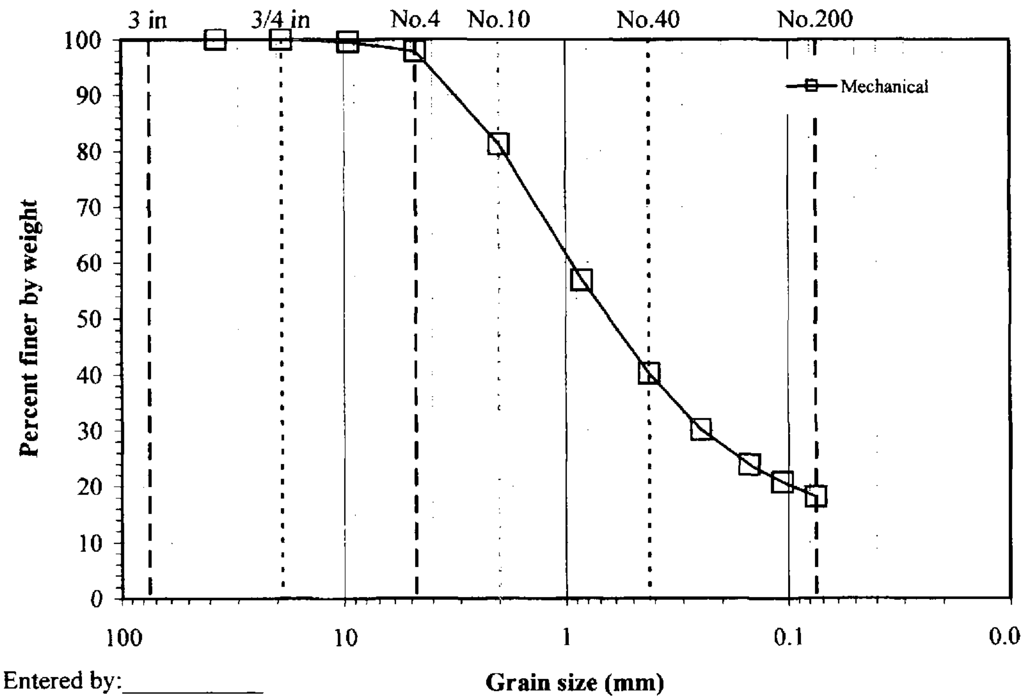
Project: CS Mining - SW Pond
No: 01640-002 (II)
Location: Milford, UT
Date: 4/18/2013
By: BRR

Boring No.: TP-29
Sample:
Depth: 4-5'
Description: Brown silty sand

Split:	Yes	
Split sieve:	3/8"	
	Moist	Dry
Total sample wt. (g):	26232.20	24429.8
+3/8" Coarse fraction (g):	114.3	110.4
-3/8" Split fraction (g):	1132.12	1054.16
Split fraction:	0.995	

Water content data	C.F.(+3/8")	S.F.(-3/8")
Moist soil + tare (g):	242.80	1442.63
Dry soil + tare (g):	238.94	1364.67
Tare (g):	128.50	310.51
Water content (%):	3.5	7.4

Sieve	Accum. Wt. Ret. (g)	Grain Size (mm)	Percent Finer
8"	-	200	-
6"	-	150	-
4"	-	100	-
3"	-	75	-
1.5"	-	37.5	100.0
3/4"	2.80	19	100.0
3/8"	110.44	9.5	99.5 ←Split
No.4	18.83	4.75	97.8
No.10	195.17	2	81.1
No.20	452.59	0.85	56.8
No.40	628.45	0.425	40.2
No.60	735.28	0.25	30.1
No.100	801.68	0.15	23.8
No.140	834.68	0.106	20.7
No.200	863.15	0.075	18.0



Gravel (%): 2.2
Sand (%): 79.7
Fines (%): 18.0

Entered by:____________
Reviewed:____________

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Laboratory Compaction Characteristics of Soil

(ASTM D698 / D1557)

IGES

Project: CS Mining - SW Pond
No: 01640-002 (II)
Location: Milford, UT
Date: 4/11/2013
By: DKS

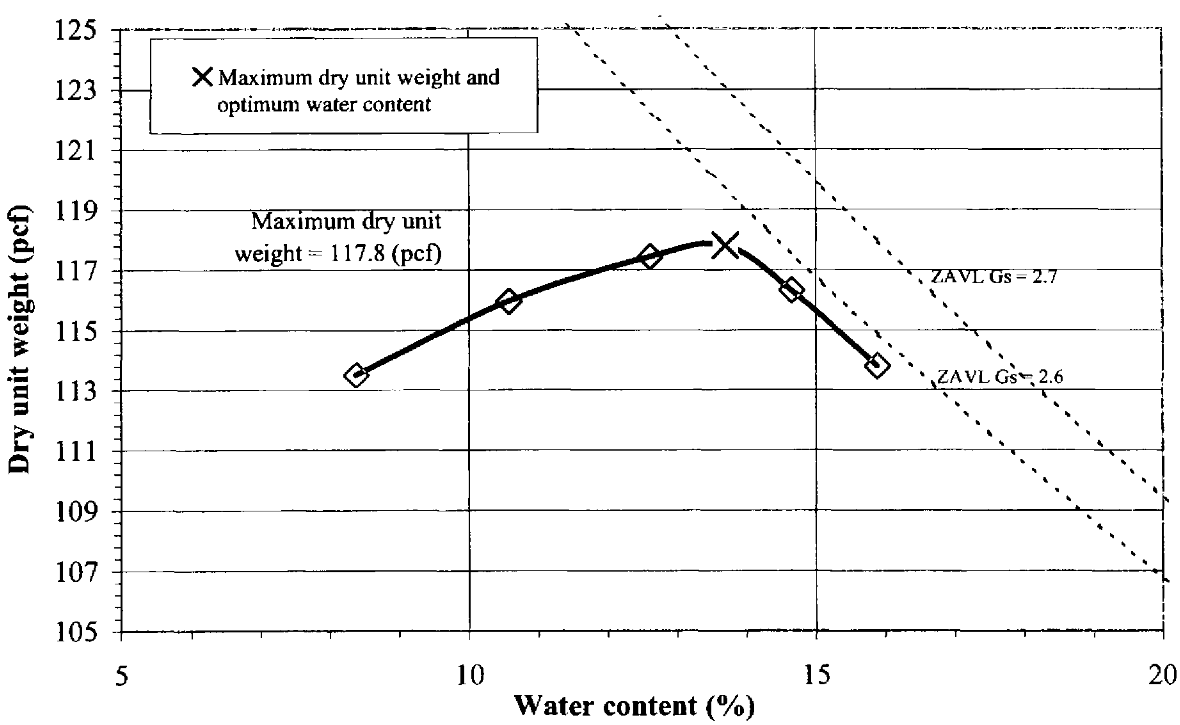
Boring No.: TP-24
Sample:
Depth: 3-4'
Sample Description: Brown silty sand
Engineering Classification: Not requested
As-received water content (%): Not requested

Method: ASTM D698 B
Mold Id. Inc 2
Mold volume (ft^3): 0.0332

Preparation method: Moist
Rammer: Mechanical-circular face
Rock Correction: No

Optimum water content (%): 13.7
Maximum dry unit weight (pcf): 117.8

Point Number	+6%	+8%	+4%	+10%	+2%			
Wt. Sample + Mold (g)	6155.5	6172.4	6094.6	6150.0	6016.7			
Wt. of Mold (g)	4162.8	4162.8	4162.8	4162.8	4162.8			
Wet Unit Wt., γ_m (pcf)	132.2	133.4	128.2	131.9	123.0			
Wet Soil + Tare (g)	821.40	797.79	711.16	815.25	793.01			
Dry Soil + Tare (g)	743.18	711.50	655.42	720.51	741.21			
Tare (g)	123.08	122.63	127.94	124.11	123.60			
Water Content, w (%)	**12.6**	14.7	**10.6**	15.9	8.4			
Dry Unit Wt., γ_d (pcf)	**117.4**	116.3	**115.9**	113.8	113.5			



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Laboratory Compaction Characteristics of Soil

(ASTM D698 / D1557)

IGES

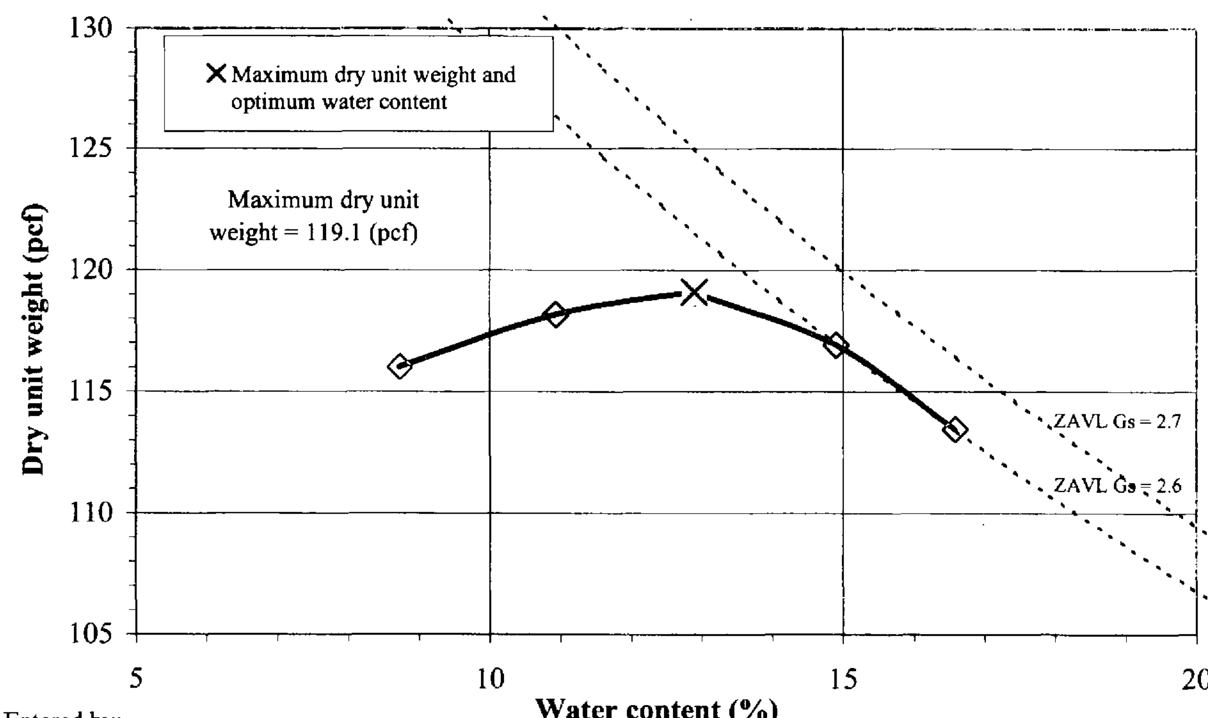
Project: CS Mining - SW Pond
No: 01640-002 (II)
Location: Milford, UT
Date: 4/17/2013
By: BRR

Method: ASTM D698 B
Mold Id. Inc 1
Mold volume (ft^3): 0.0333

Boring No.: TP-24
Sample:
Depth: 5-6'
Sample Description: Brown sand
Engineering Classification: Not requested
As-received water content (%): 4.8
Preparation method: Moist
Rammer: Mechanical-circular face
Rock Correction: No

Optimum water content (%): 12.9
Maximum dry unit weight (pcf): 119.1

Point Number	+6%	+8%	+10%	+12%	+4%			
Wt. Sample + Mold (g)	6227.4	6278.0	6276.6	6245.4	6152.6			
Wt. of Mold (g)	4247.8	4247.8	4247.8	4247.8	4247.8			
Wet Unit Wt., γ_m (pcf)	131.1	134.4	134.3	132.3	126.1			
Wet Soil + Tare (g)	790.61	825.28	838.11	835.63	670.69			
Dry Soil + Tare (g)	724.87	747.08	745.60	734.86	628.25			
Tare (g)	123.52	140.98	124.48	127.11	141.71			
Water Content, w (%)	**10.9**	12.9	**14.9**	16.6	8.7			
Dry Unit Wt., γ_d (pcf)	**118.2**	119.1	**116.9**	113.5	116.0			



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Laboratory Compaction Characteristics of Soil

(ASTM D698 / D1557)

IGES

Project: CS Mining - SW Pond
No: 01640-002 (II)
Location: Milford, UT
Date: 4/12/2013
By: DKS

Method: ASTM D698 B
Mold Id. Inc 3
Mold volume (ft^3): 0.0332

Boring No.: TP-25
Sample:
Depth: 2-3'
Sample Description: Brown silty sand with gravel
Engineering Classification: Not requested
As-received water content (%): Not requested
Preparation method: Moist
Rammer: Mechanical-circular face
Rock Correction: Yes * See results below
Percent fraction retained, Pc (%) 10.6
Percent fraction passing, Pf (%) 89.4

Optimum water content (%): 15.6
Maximum dry unit weight (pcf): 111.4

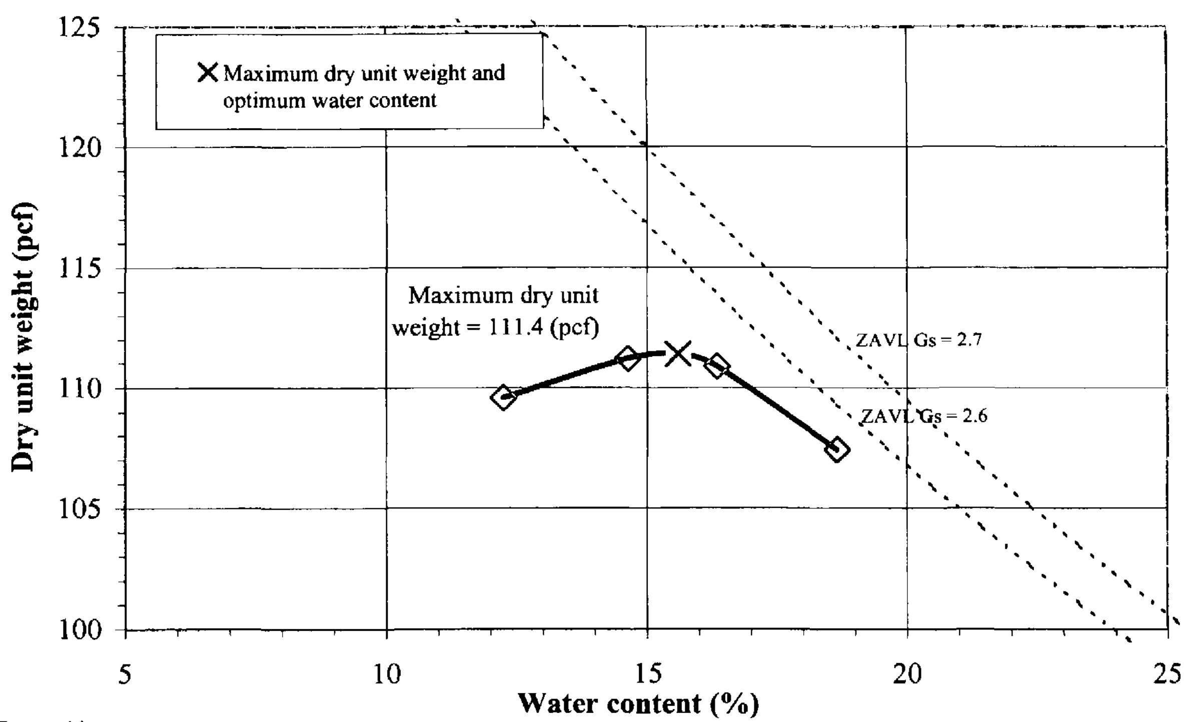
Point Number	+4%	+6%	+8%	+2%				
Wt. Sample + Mold (g)	6093.5	6116.6	6093.4	6026.1				
Wt. of Mold (g)	4172.4	4172.4	4172.4	4172.4				
Wet Unit Wt., γ_m (pcf)	127.5	129.0	127.5	123.0				
Wet Soil + Tare (g)	671.43	637.83	578.61	797.72				
Dry Soil + Tare (g)	601.94	567.87	506.53	724.58				
Tare (g)	127.25	139.83	120.01	127.12				
Water Content, w (%)	**14.6**	**16.3**	**18.6**	**12.2**				
Dry Unit Wt., γ_d (pcf)	**111.2**	**110.9**	**107.4**	**109.6**				

***Correction of Unit Weight and Water Content for Soils Containing Oversize Particles**

(ASTM D4718)

Corrected water content (%): 14.5
Corrected dry unit weight (pcf): 115.4

Oversized fraction, +3/8-in. (%): 10.6
Water content, +3/8-in. (%): 5.0
Sieve for oversized fraction: 3/8-in.
Bulk specific gravity, Gs: 2.65 Assumed



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Laboratory Compaction Characteristics of Soil

(ASTM D698 / D1557)

IGES

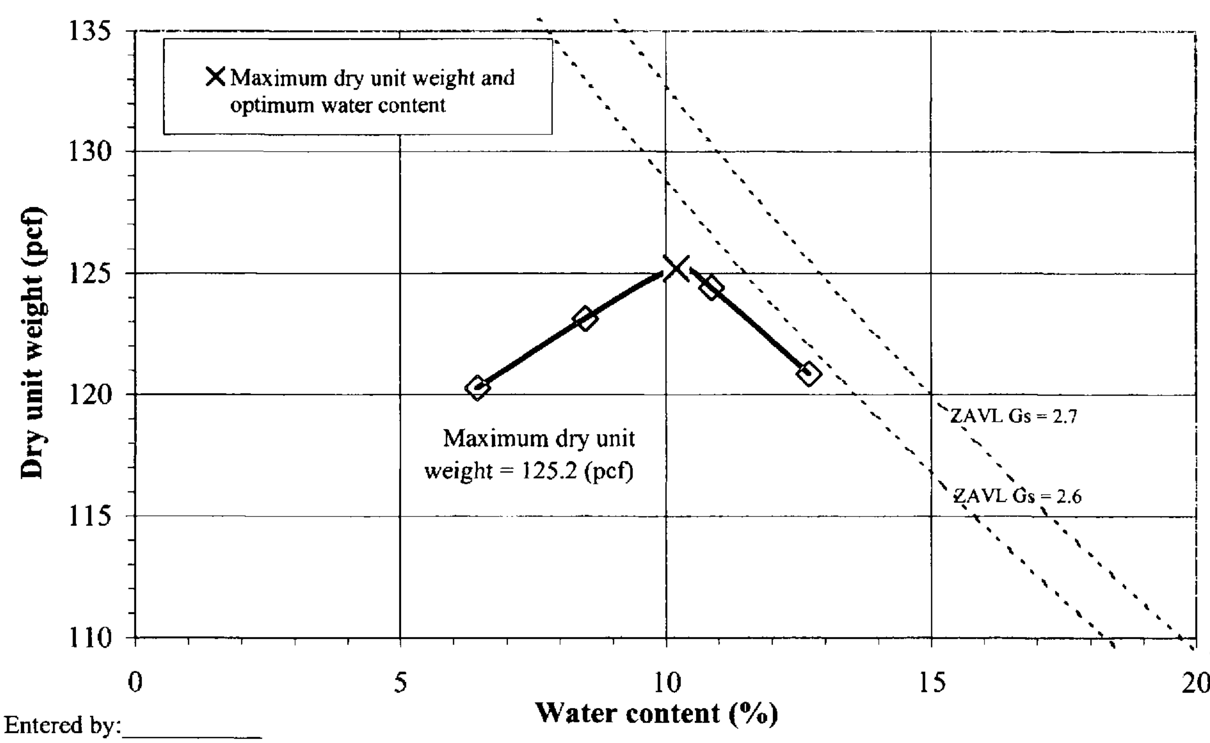
Project: CS Mining - SW Pond
No: 01640-002 (II)
Location: Milford, UT
Date: 4/17/2013
By: BRR

Method: ASTM D698 B
Mold Id. Inc 3
Mold volume (ft^3): 0.0332

Boring No.: TP-26
Sample:
Depth: 2-3'
Sample Description: Brown silty sand
Engineering Classification: Not requested
As-received water content (%): 6.4
Preparation method: Moist
Rammer: Mechanical-circular face
Rock Correction: No

Optimum water content (%): 10.2
Maximum dry unit weight (pcf): 125.2

Point Number	+4%	+6%	+2%	As Is				
Wt. Sample + Mold (g)	6251.1	6225.2	6185.3	6101.7				
Wt. of Mold (g)	4172.3	4172.3	4172.3	4172.3				
Wet Unit Wt., γ_m (pcf)	137.9	136.2	133.6	128.0				
Wet Soil + Tare (g)	832.60	837.33	824.06	780.94				
Dry Soil + Tare (g)	763.10	756.78	769.65	741.14				
Tare (g)	123.39	122.18	127.42	123.96				
Water Content, w (%)	**10.9**	12.7	**8.5**	6.4				
Dry Unit Wt., γ_d (pcf)	**124.4**	120.9	**123.1**	120.3				



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Laboratory Compaction Characteristics of Soil
(ASTM D698 / D1557)

IGES

Project: CS Mining - SW Pond
No: 01640-002 (II)
Location: Milford, UT
Date: 4/17/2013
By: BRR

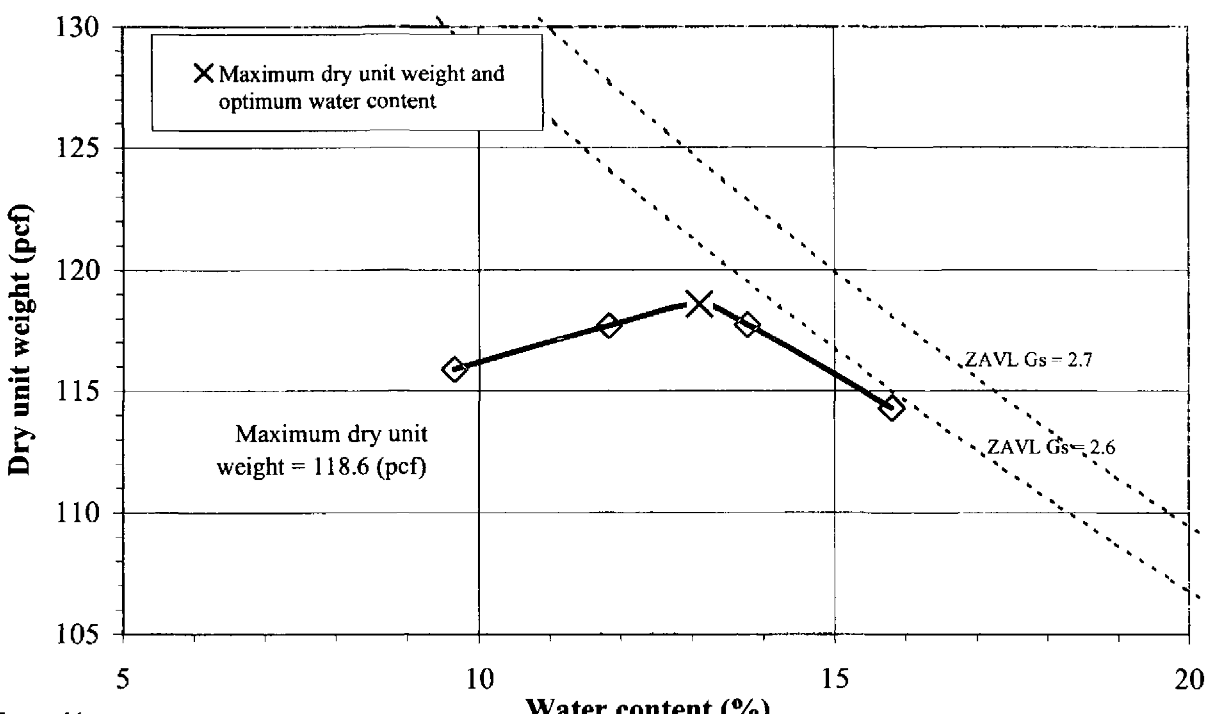
Boring No.: TP-29
Sample:
Depth: 4-5'
Sample Description: Brown silty sand
Engineering Classification: Not requested
As-received water content (%): Not requested

Method: ASTM D698 B
Mold Id. Inc 3
Mold volume (ft^3): 0.0332

Preparation method: Moist
Rammer: Mechanical-circular face
Rock Correction: No

Optimum water content (%): 13.1
Maximum dry unit weight (pcf): 118.6

Point Number	+4%	+6%	+8%	+2%				
Wt. Sample + Mold (g)	6155.9	6191.1	6167.5	6087.3				
Wt. of Mold (g)	4172.3	4172.3	4172.3	4172.3				
Wet Unit Wt., γ_m (pcf)	131.6	134.0	132.4	127.1				
Wet Soil + Tare (g)	727.00	771.89	625.38	812.10				
Dry Soil + Tare (g)	662.63	693.88	556.36	752.98				
Tare (g)	118.40	127.43	119.91	140.33				
Water Content, w (%)	**11.8**	**13.8**	**15.8**	**9.6**				
Dry Unit Wt., γ_d (pcf)	**117.7**	**117.7**	**114.3**	**115.9**				



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Identification and Classification of Dispersive Clay Soils by the Pinhole Test

(ASTM D 4647 Method A)

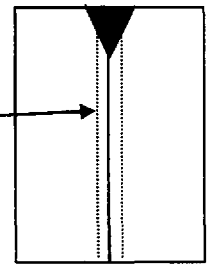
IGES

Project: CS Mining-SW Pond
No: 01640-002 (II)
Location: Milford, UT
Date: 4/22/13
By: BRR

Boring No.: TP-21
Sample:
Depth: 4.5-5'
Test Specification: Client specified 116 pcf at 12% moisture content
Visual Description: Brown sand with silt
Engineering Classification Not requested

Type of test: Method A
Sample type: Remolded
Water content (%): 12
Dry unit weight (pcf): 116

Specimen After Test
Final Hole (mm): >=1.5



Dispersive Classification: ND2 - Nondispersive

Clock Time	Head (in)	Flow ml	Flow sec	Flow Rate (ml/sec)	Turbidity From Side: Very Dark	Dark	Moderately Dark	Slightly Dark	Barely Visible	Completely Clear	Completely Clear From Top	Particles Falling: None	Few	Heavy	Remarks
0:00	2	23.0	60	0,4					X			X			
	2	25.0	60	0.4					X			X			
0:05	2	26.0	60	0.4					X			X			
	2	23.0	60	0.4					X			X			
0:10	7	54.0	60	0.9					X			X			
	7	49.0	60	0.8					X			X			
	7	48.0	60	0.8					X			X			
0:15	15	84.0	60	1.4					X			X			
	15	83.0	60	1.4					X			X			
0:20	40	78.0	30	2.6				X					X		
	40	75.0	30	2.5				X					X		
0:25	40	76.0	30	2.5				X					X		
	40	78.0	30	2.6			X							X	
0:27	40	78.0	30	2.6			X							X	

Entered by:___________
Reviewed:___________

Identification and Classification of Dispersive Clay Soils by the Pinhole Test

(ASTM D 4647 Method A)

IGES

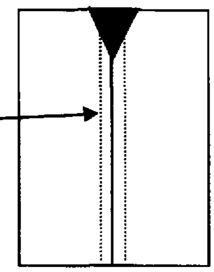
Project: CS Mining-SW Pond
No: 01640-002 (II)
Location: Milford, UT
Date: 4/22/13
By: BRR

Boring No.: TP-24
Sample:
Depth: 5-6'
Test Specification: 95% of ASTM D698 at optimum water content +2%.
Visual Description: Brown sand

Type of test: Method A
Sample type: Remolded
Water content (%): 14.9
Dry unit weight (pcf): 113.1

Engineering Classification Not requested

Specimen After Test
Final Hole (mm): >=1.5



Dispersive Classification: ND3 - Moderately to Slightly Dispersive

Clock Time	Head (in)	Flow			Turbidity From Side						Completely Clear From Top	Particles Falling			Remarks
		ml	sec	Rate (ml/sec)	Very Dark	Dark	Moderately Dark	Slightly Dark	Barely Visible	Completely Clear		None	Few	Heavy	
0:00	2	25.0	60	0.4					X			X			
	2	26.0	60	0.4					X			X			
0:05	2	25.0	60	0.4					X			X			
	2	26.0	60	0.4					X			X			
	2	25.0	60	0.4					X			X			
0:10	7	57.0	60	1.0					X			X			
	7	57.0	60	1.0					X			X			
	7	57.0	60	1.0					X			X			
0:15	15	92.0	60	1.5				X					X		
	15	71.0	45	1.6				X					X		
	15	48.0	30	1.6				X					X		

Entered by:____________

Reviewed:____________

Identification and Classification of Dispersive Clay Soils by the Pinhole Test

IGES

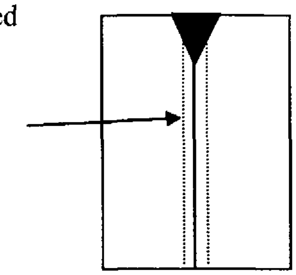
(ASTM D 4647 Method A)

Project: CS Mining-SW Pond
No: 01640-002 (II)
Location: Milford, UT
Date: 4/22/13
By: BRR

Boring No.: TP-26
Sample:
Depth: 2-3'
Test Specification: 95% of ASTM D698 at optimum water content +2%.
Visual Description: Brown silty sand
Engineering Classification Not requested

Type of test: Method A
Sample type: Remolded
Water content (%): 12.2
Dry unit weight (pcf): 118.9

Specimen After Test
Final Hole (mm): >1.5



Dispersive Classification: ND3 - Moderately to Slightly Dispersive

Clock Time	Head (in)	Flow: ml	Flow: sec	Flow: Rate (ml/sec)	Turbidity From Side: Very Dark	Dark	Moderately Dark	Slightly Dark	Barely Visible	Completely Clear	Completely Clear From Top	Particles Falling: None	Few	Heavy	Remarks
0:00	2	28.0	60	0.5				X					X		
	2	28.0	60	0.5				X					X		
0:05	2	28.0	60	0.5				X					X		
	2	27.0	60	0.5					X			X			
0:10	7	58.0	60	1.0				X					X		
	7	57.0	60	1.0					X			X			
0:15	15	63.0	40	1.6				X					X		
	15	71.0	45	1.6			X							X	
	15	40.0	30	1.3			X							X	

Entered by:___________

Reviewed:___________

Direct Shear Test for Soils Under Drained Conditions

(ASTM D3080)

Project: CS Mining - SW Pond
No: 01640-002 (II)
Location: Milfrod, UT
Date: 4/22/2013
By: JDF

Boring No.: TP-24
Sample:
Depth: 5-6'
Sample Description: Brown sand
Sample type: Laboratory compacted
Dry unit weight 113.1 pcf
at 14.9 (%) w
Compaction specifications: 95% of ASTM D698B

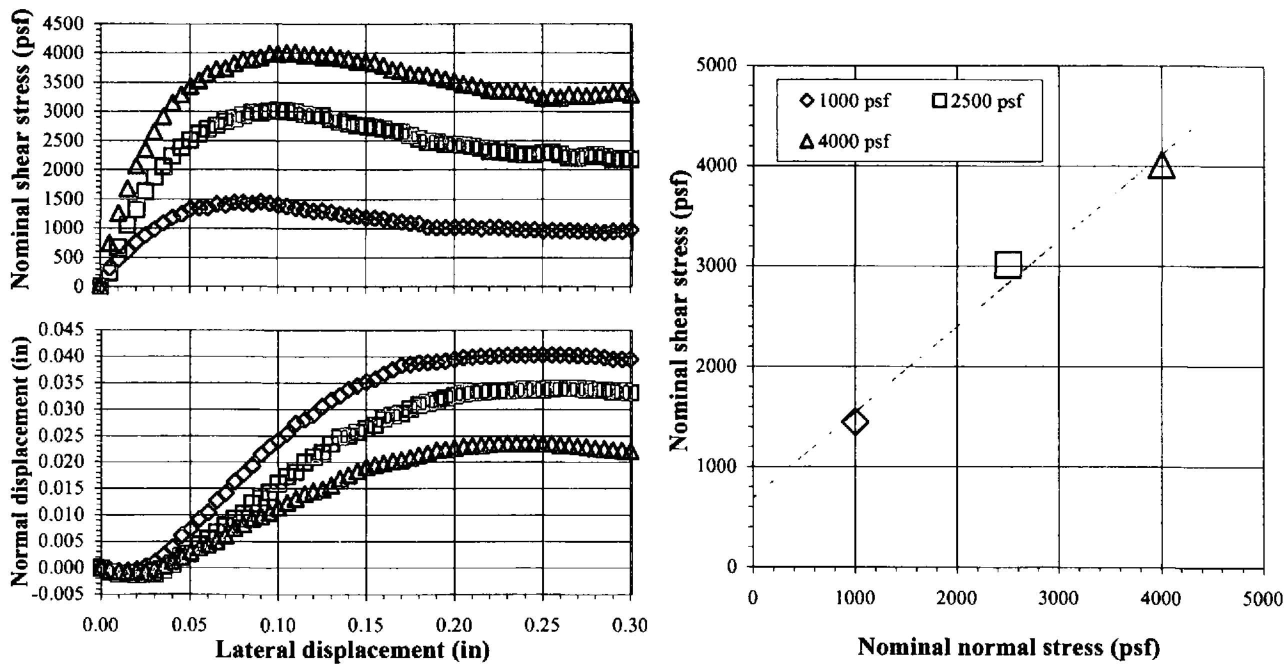
Test type: Inundated
Lateral displacement (in.): 0.3
Shear rate (in./min): 0.0200
Specific gravity, Gs: 2.65 Assumed

	Sample 1		Sample 2		Sample 3	
Nominal normal stress (psf)	1000		2500		4000	
Peak shear stress (psf)	1449		3013		4015	
Lateral displacement at peak (in)	0.090		0.100		0.110	
	Initial	Pre-shear	Initial	Pre-shear	Initial	Pre-shear
Sample height (in)	1.0000	0.9868	1.0000	0.9749	1.0000	0.9746
Sample diameter (in)	2.416	2.416	2.416	2.416	2.416	2.416
Wt. rings + wet soil (g)	199.01	201.37	199.28	200.74	199.06	200.50
Wt. rings (g)	42.42	42.42	42.69	42.69	42.47	42.47
Wet soil + tare (g)	316.57		316.57		316.57	
Dry soil + tare (g)	292.02		292.02		292.02	
Tare (g)	127.87		127.87		127.87	
Water content (%)	15.0	16.7	15.0	16.0	15.0	16.0
Dry unit weight (pcf)	113.2	114.7	113.2	116.1	113.2	116.1
Void ratio, e, for assumed Gs	0.46	0.44	0.46	0.42	0.46	0.42
Saturation (%)*	85.9	100.0	85.9	100.0	85.9	100.0

ϕ' (deg)	41
c' (psf)	687

Average of 3 samples	Initial	Pre-shear
Water content (%)	15.0	16.2
Dry unit weight (pcf)	113.2	115.6

*Pre-shear saturation set to 100% for phase calculations



Entered by:__________
Reviewed:__________

Nominal normal stress = 1000 psf			Nominal normal stress = 2500 psf			Nominal normal stress = 4000 psf		
Lateral Displacement (in.)	Nominal Shear Stress (psf)	Normal Displacement (in.)	Lateral Displacement (in.)	Nominal Shear Stress (psf)	Normal Displacement (in.)	Lateral Displacement (in.)	Nominal Shear Stress (psf)	Normal Displacement (in.)
0.000	1	0.000	0.000	-2	0.000	0.000	0	0.000
0.005	319	0.000	0.005	236	-0.001	0.005	742	0.000
0.010	468	-0.001	0.010	671	-0.001	0.010	1255	-0.001
0.015	607	-0.001	0.015	1046	-0.001	0.015	1674	-0.001
0.020	753	0.000	0.020	1313	-0.001	0.020	2062	-0.001
0.025	877	0.000	0.025	1624	-0.001	0.025	2346	-0.001
0.030	975	0.001	0.030	1872	-0.001	0.030	2644	0.000
0.035	1091	0.002	0.035	2056	0.000	0.035	2905	0.000
0.040	1184	0.004	0.040	2231	0.001	0.040	3143	0.001
0.045	1241	0.006	0.045	2377	0.002	0.045	3283	0.002
0.050	1331	0.007	0.050	2503	0.003	0.050	3433	0.003
0.055	1347	0.009	0.055	2612	0.004	0.055	3531	0.004
0.060	1358	0.010	0.060	2698	0.006	0.060	3645	0.004
0.065	1417	0.013	0.065	2754	0.007	0.065	3725	0.005
0.070	1406	0.014	0.070	2829	0.008	0.070	3735	0.006
0.075	1443	0.016	0.075	2877	0.009	0.075	3818	0.007
0.080	1437	0.018	0.080	2928	0.010	0.080	3880	0.008
0.085	1415	0.019	0.085	2975	0.012	0.085	3896	0.009
0.090	1449	0.021	0.090	2978	0.013	0.090	3924	0.010
0.095	1423	0.023	0.095	3001	0.014	0.095	3989	0.011
0.100	1406	0.024	0.100	3013	0.016	0.100	3981	0.011
0.105	1377	0.025	0.105	3009	0.017	0.105	4004	0.012
0.110	1348	0.027	0.110	2989	0.018	0.110	4015	0.013
0.115	1321	0.028	0.115	2951	0.020	0.115	3968	0.014
0.120	1292	0.029	0.120	2933	0.021	0.120	3976	0.015
0.125	1297	0.031	0.125	2926	0.022	0.125	3942	0.015
0.130	1273	0.032	0.130	2864	0.023	0.130	3971	0.016
0.135	1239	0.033	0.135	2821	0.025	0.135	3924	0.017
0.140	1211	0.034	0.140	2791	0.025	0.140	3903	0.018
0.145	1203	0.035	0.145	2755	0.026	0.145	3857	0.018
0.150	1183	0.035	0.150	2750	0.026	0.150	3849	0.019
0.155	1174	0.036	0.155	2724	0.027	0.155	3831	0.019
0.160	1161	0.037	0.160	2701	0.028	0.160	3792	0.020
0.165	1129	0.038	0.165	2656	0.029	0.165	3715	0.020
0.170	1112	0.038	0.170	2645	0.029	0.170	3704	0.020
0.175	1088	0.039	0.175	2595	0.030	0.175	3647	0.021
0.180	1079	0.039	0.180	2530	0.031	0.180	3632	0.021
0.185	1022	0.039	0.185	2485	0.031	0.185	3621	0.022
0.190	1011	0.039	0.190	2476	0.032	0.190	3588	0.022
0.195	1013	0.039	0.195	2441	0.032	0.195	3554	0.022
0.200	1015	0.039	0.200	2441	0.033	0.200	3521	0.023
0.205	1020	0.040	0.205	2418	0.033	0.205	3474	0.023
0.210	1020	0.040	0.210	2407	0.033	0.210	3445	0.023
0.215	997	0.040	0.215	2374	0.033	0.215	3414	0.023
0.220	1014	0.040	0.220	2320	0.033	0.220	3368	0.023
0.225	1015	0.040	0.225	2325	0.033	0.225	3352	0.024
0.230	988	0.040	0.230	2294	0.034	0.230	3345	0.024
0.235	986	0.040	0.235	2271	0.034	0.235	3345	0.024
0.240	970	0.040	0.240	2251	0.034	0.240	3324	0.024
0.245	973	0.040	0.245	2259	0.034	0.245	3290	0.024
0.250	959	0.040	0.250	2283	0.034	0.250	3228	0.024
0.255	964	0.040	0.255	2296	0.034	0.255	3259	0.024
0.260	959	0.040	0.260	2256	0.034	0.260	3239	0.023
0.265	963	0.040	0.265	2213	0.034	0.265	3285	0.023
0.270	953	0.040	0.270	2199	0.034	0.270	3275	0.023
0.275	944	0.040	0.275	2229	0.034	0.275	3264	0.023
0.280	934	0.040	0.280	2253	0.034	0.280	3277	0.023
0.285	928	0.040	0.285	2223	0.034	0.285	3295	0.023
0.290	947	0.039	0.290	2176	0.033	0.290	3316	0.022
0.295	954	0.039	0.295	2185	0.033	0.295	3324	0.022
0.300	980	0.039	0.300	2183	0.033	0.300	3290	0.022

Direct Shear Test for Soils Under Drained Conditions

(ASTM D3080)

IGES

Project: CS Mining - SW Pond
No: 01640-002 (II)
Location: Milfrod, UT
Date: 4/22/2013
By: JDF

Boring No.: TP-26
Sample:
Depth: 2-3'
Sample Description: Brown silty sand
Sample type: Laboratory compacted
Dry unit weight 118.9 pcf
at 12.2 (%) w
Compaction specifications: 95% of ASTM D698B

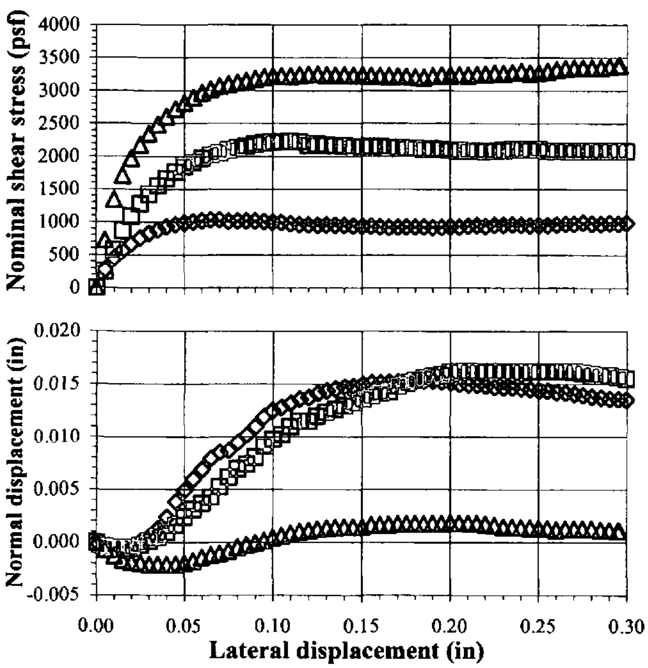
Test type: Inundated
Lateral displacement (in.): 0.3
Shear rate (in./min): 0.0033
Specific gravity, Gs: 2.65 Assumed

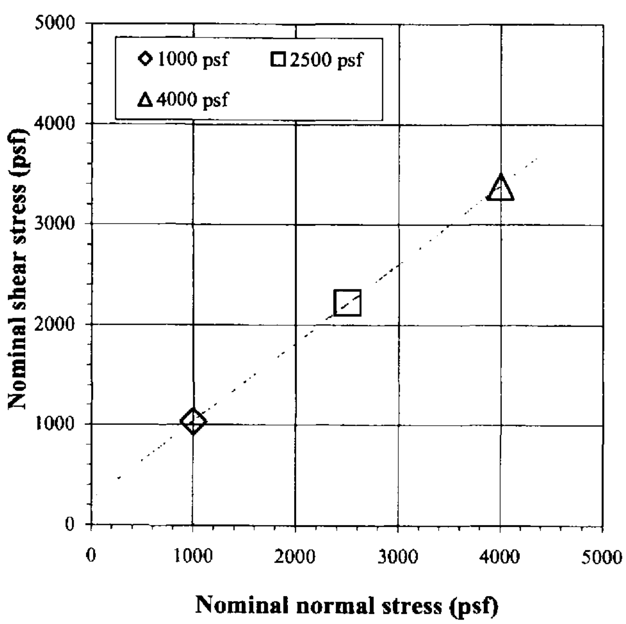
	Sample 1		Sample 2		Sample 3	
Nominal normal stress (psf)	1000		2500		4000	
Peak shear stress (psf)	1032		2224		3381	
Lateral displacement at peak (in)	0.070		0.110		0.296	
	Initial	Pre-shear	Initial	Pre-shear	Initial	Pre-shear
Sample height (in)	1.0000	0.9876	1.0000	0.9817	1.0000	0.9742
Sample diameter (in)	2.416	2.416	2.416	2.416	2.416	2.416
Wt. rings + wet soil (g)	203.31	206.16	202.90	205.31	203.92	205.77
Wt. rings (g)	42.57	42.57	42.16	42.16	43.18	43.18
Wet soil + tare (g)	332.26		332.26		332.26	
Dry soil + tare (g)	310.03		310.03		310.03	
Tare (g)	123.94		123.94		123.94	
Water content (%)	11.9	13.9	11.9	13.6	11.9	13.2
Dry unit weight (pcf)	119.3	120.8	119.3	121.5	119.3	122.4
Void ratio, e, for assumed Gs	0.39	0.37	0.39	0.36	0.39	0.35
Saturation (%)*	81.9	100.0	81.9	100.0	81.9	100.0

ϕ' (deg)	38
c' (psf)	255

Average of 3 samples	Initial	Pre-shear
Water content (%)	11.9	13.6
Dry unit weight (pcf)	119.3	121.6

*Pre-shear saturation set to 100% for phase calculations





Entered by:__________
Reviewed:__________

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Nominal normal stress = 1000 psf			Nominal normal stress = 2500 psf			Nominal normal stress = 4000 psf		
Lateral Displacement (in.)	Nominal Shear Stress (psf)	Normal Displacement (in.)	Lateral Displacement (in.)	Nominal Shear Stress (psf)	Normal Displacement (in.)	Lateral Displacement (in.)	Nominal Shear Stress (psf)	Normal Displacement (in.)
0.000	-3	0.000	0.000	0	0.000	0.000	0	0.000
0.005	275	0.000	0.005	244	0.000	0.005	727	-0.001
0.010	443	-0.001	0.010	573	-0.001	0.010	1342	-0.001
0.015	563	-0.001	0.015	861	-0.001	0.015	1710	-0.002
0.020	664	-0.001	0.020	1083	-0.001	0.020	1971	-0.002
0.025	755	0.000	0.025	1270	0.000	0.025	2173	-0.002
0.030	822	0.001	0.030	1417	0.000	0.030	2344	-0.002
0.035	879	0.001	0.035	1552	0.000	0.035	2481	-0.002
0.040	925	0.002	0.040	1657	0.001	0.040	2602	-0.002
0.045	965	0.004	0.045	1759	0.002	0.045	2719	-0.002
0.050	989	0.005	0.050	1844	0.002	0.050	2814	-0.002
0.055	1005	0.006	0.055	1908	0.003	0.055	2897	-0.002
0.060	1020	0.007	0.060	1972	0.004	0.060	2967	-0.001
0.065	1029	0.008	0.065	2020	0.004	0.065	3016	-0.001
0.070	1032	0.008	0.070	2055	0.005	0.070	3065	-0.001
0.075	1009	0.009	0.075	2096	0.006	0.075	3091	-0.001
0.080	1013	0.009	0.080	2129	0.007	0.080	3125	0.000
0.085	1015	0.010	0.085	2152	0.007	0.085	3145	0.000
0.090	1014	0.011	0.090	2187	0.008	0.090	3174	0.000
0.095	1005	0.012	0.095	2208	0.009	0.095	3202	0.000
0.100	1001	0.013	0.100	2216	0.010	0.100	3218	0.000
0.105	992	0.013	0.105	2223	0.010	0.105	3220	0.001
0.110	977	0.013	0.110	2224	0.011	0.110	3218	0.001
0.115	961	0.014	0.115	2221	0.012	0.115	3236	0.001
0.120	957	0.014	0.120	2164	0.012	0.120	3244	0.001
0.125	952	0.014	0.125	2183	0.012	0.125	3244	0.001
0.130	954	0.014	0.130	2171	0.012	0.130	3236	0.001
0.135	951	0.015	0.135	2165	0.013	0.135	3233	0.001
0.140	948	0.015	0.140	2154	0.013	0.140	3236	0.001
0.145	940	0.015	0.145	2146	0.013	0.145	3231	0.001
0.150	936	0.015	0.150	2148	0.014	0.150	3236	0.001
0.155	937	0.015	0.155	2151	0.014	0.155	3228	0.002
0.160	928	0.015	0.160	2145	0.014	0.160	3223	0.002
0.165	918	0.015	0.165	2137	0.014	0.165	3220	0.002
0.170	923	0.015	0.170	2133	0.015	0.170	3215	0.002
0.175	928	0.015	0.175	2122	0.015	0.175	3215	0.002
0.180	926	0.015	0.180	2125	0.015	0.180	3205	0.002
0.185	925	0.015	0.185	2110	0.016	0.185	3200	0.002
0.190	919	0.015	0.190	2115	0.016	0.190	3223	0.002
0.195	923	0.015	0.195	2108	0.016	0.195	3236	0.002
0.200	932	0.015	0.200	2097	0.016	0.200	3233	0.002
0.205	928	0.015	0.205	2093	0.016	0.205	3241	0.002
0.210	941	0.015	0.210	2085	0.016	0.210	3236	0.002
0.215	949	0.015	0.215	2085	0.016	0.215	3239	0.002
0.220	937	0.015	0.220	2082	0.016	0.220	3251	0.002
0.225	954	0.015	0.225	2085	0.016	0.225	3262	0.002
0.230	953	0.015	0.230	2095	0.016	0.230	3259	0.001
0.235	963	0.015	0.235	2103	0.016	0.235	3267	0.001
0.240	954	0.015	0.240	2110	0.016	0.240	3290	0.001
0.245	944	0.015	0.245	2101	0.016	0.245	3262	0.001
0.250	951	0.014	0.250	2115	0.016	0.250	3267	0.001
0.255	952	0.014	0.255	2081	0.016	0.255	3293	0.001
0.260	958	0.014	0.260	2085	0.016	0.260	3314	0.001
0.265	972	0.014	0.265	2083	0.016	0.265	3334	0.001
0.270	975	0.014	0.270	2073	0.016	0.270	3342	0.001
0.275	990	0.014	0.275	2085	0.016	0.275	3342	0.001
0.280	980	0.014	0.280	2081	0.016	0.280	3342	0.001
0.285	973	0.014	0.285	2084	0.016	0.285	3350	0.001
0.290	987	0.014	0.290	2080	0.016	0.290	3363	0.001
0.295	979	0.014	0.295	2083	0.016	0.295	3376	0.001
0.299	990	0.014	0.299	2079	0.016	0.296	3381	0.001

Direct Shear Test for Soils Under Drained Conditions

(ASTM D3080)

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Project: CS Mining - SW Pond
No: 01640-002 (II)
Location: Milfrod, UT
Date: 4/22/2013
By: NB

Boring No.: TP-29
Sample:
Depth: 4-5'
Sample Description: Brown silty sand
Sample type: Laboratory compacted
Dry unit weight 112.7 pcf
at 15.1 (%) w
Compaction specifications: 95% of ASTM D698B

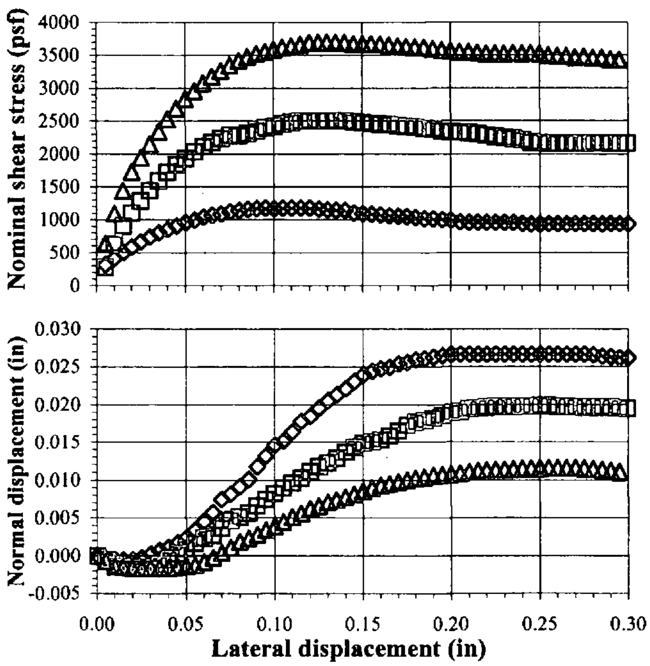
Test type: Inundated
Lateral displacement (in.): 0.3
Shear rate (in./min): 0.0033
Specific gravity, Gs: 2.65 Assumed

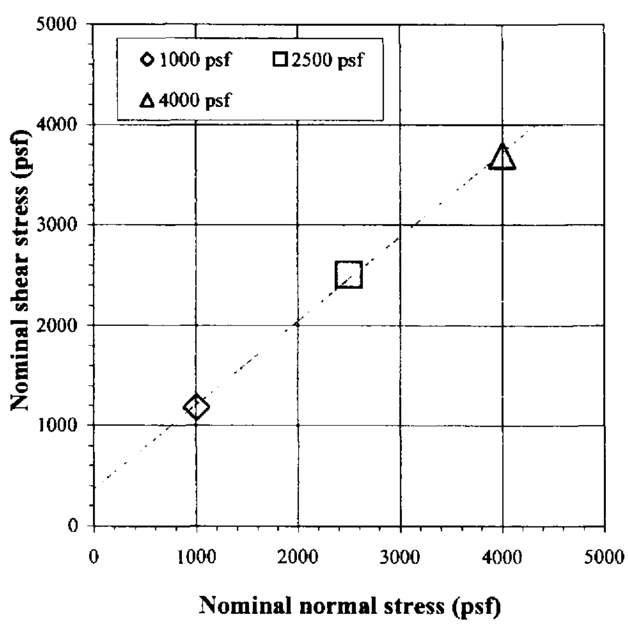
	Sample 1		Sample 2		Sample 3	
Nominal normal stress (psf)	1000		2500		4000	
Peak shear stress (psf)	1180		2506		3694	
Lateral displacement at peak (in)	0.110		0.130		0.125	
	Initial	Pre-shear	Initial	Pre-shear	Initial	Pre-shear
Sample height (in)	1.0000	0.9902	1.0000	0.9859	1.0000	0.9762
Sample diameter (in)	2.416	2.416	2.416	2.416	2.416	2.416
Wt. rings + wet soil (g)	198.66	201.56	198.66	201.24	198.66	200.50
Wt. rings (g)	42.46	42.46	42.46	42.46	42.46	42.46
Wet soil + tare (g)	378.21		378.21		378.21	
Dry soil + tare (g)	345.89		345.89		345.89	
Tare (g)	127.69		127.69		127.69	
Water content (%)	14.8	16.9	14.8	16.7	14.8	16.2
Dry unit weight (pcf)	113.1	114.1	113.1	114.6	113.1	115.8
Void ratio, e, for assumed Gs	0.46	0.45	0.46	0.44	0.46	0.43
Saturation (%)*	84.7	100.0	84.7	100.0	84.7	100.0

ϕ' (deg)	40
c' (psf)	365

Average of 3 samples	Initial	Pre-shear
Water content (%)	14.8	16.6
Dry unit weight (pcf)	113.1	114.8

*Pre-shear saturation set to 100% for phase calculations





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Reviewed:__________

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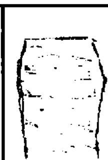
Nominal normal stress = 1000 psf			Nominal normal stress = 2500 psf			Nominal normal stress = 4000 psf		
Lateral Displacement (in.)	Nominal Shear Stress (psf)	Normal Displacement (in.)	Lateral Displacement (in.)	Nominal Shear Stress (psf)	Normal Displacement (in.)	Lateral Displacement (in.)	Nominal Shear Stress (psf)	Normal Displacement (in.)
0.000	-3	0.000	0.000	-4	0.000	0.000	-3	0.000
0.005	319	0.000	0.005	277	-0.001	0.005	636	-0.001
0.010	412	-0.001	0.010	625	-0.001	0.010	1092	-0.001
0.015	500	-0.001	0.015	901	-0.002	0.015	1441	-0.002
0.020	578	-0.001	0.020	1097	-0.002	0.020	1723	-0.002
0.025	663	0.000	0.025	1281	-0.002	0.025	1943	-0.002
0.030	736	0.000	0.030	1437	-0.002	0.030	2147	-0.002
0.035	799	0.001	0.035	1587	-0.001	0.035	2331	-0.002
0.040	853	0.001	0.040	1719	-0.001	0.040	2525	-0.002
0.045	902	0.002	0.045	1834	0.000	0.045	2685	-0.002
0.050	955	0.002	0.050	1928	0.001	0.050	2830	-0.001
0.055	996	0.003	0.055	2031	0.002	0.055	2951	-0.001
0.060	1037	0.005	0.060	2110	0.002	0.060	3068	-0.001
0.065	1066	0.006	0.065	2175	0.003	0.065	3171	0.000
0.070	1090	0.007	0.070	2237	0.004	0.070	3259	0.000
0.075	1121	0.008	0.075	2281	0.005	0.075	3342	0.001
0.080	1143	0.009	0.080	2276	0.005	0.080	3414	0.002
0.085	1159	0.010	0.085	2309	0.006	0.085	3474	0.002
0.090	1167	0.012	0.090	2353	0.007	0.090	3521	0.003
0.095	1176	0.013	0.095	2398	0.007	0.095	3554	0.003
0.100	1170	0.015	0.100	2419	0.008	0.100	3585	0.004
0.105	1172	0.015	0.105	2454	0.009	0.105	3616	0.004
0.110	1180	0.016	0.110	2478	0.010	0.110	3639	0.005
0.115	1176	0.018	0.115	2500	0.010	0.115	3660	0.006
0.120	1178	0.018	0.120	2504	0.011	0.120	3686	0.006
0.125	1166	0.020	0.125	2505	0.012	0.125	3694	0.007
0.130	1150	0.021	0.130	2506	0.012	0.130	3691	0.007
0.135	1142	0.021	0.135	2506	0.013	0.135	3686	0.007
0.140	1140	0.022	0.140	2499	0.014	0.140	3686	0.008
0.145	1104	0.023	0.145	2482	0.014	0.145	3671	0.008
0.150	1096	0.024	0.150	2473	0.015	0.150	3671	0.009
0.155	1085	0.024	0.155	2460	0.015	0.155	3671	0.009
0.160	1072	0.025	0.160	2448	0.015	0.160	3665	0.009
0.165	1056	0.025	0.165	2444	0.016	0.165	3650	0.010
0.170	1051	0.025	0.170	2426	0.017	0.170	3639	0.010
0.175	1048	0.026	0.175	2416	0.017	0.175	3629	0.010
0.180	1033	0.026	0.180	2406	0.018	0.180	3621	0.010
0.185	1019	0.026	0.185	2387	0.018	0.185	3616	0.010
0.190	1014	0.026	0.190	2374	0.018	0.190	3593	0.011
0.195	1001	0.026	0.195	2348	0.019	0.195	3575	0.011
0.200	995	0.027	0.200	2331	0.019	0.200	3564	0.011
0.205	970	0.027	0.205	2329	0.019	0.205	3549	0.011
0.210	964	0.027	0.210	2325	0.020	0.210	3546	0.011
0.215	959	0.027	0.215	2305	0.020	0.215	3539	0.011
0.220	960	0.027	0.220	2287	0.020	0.220	3523	0.011
0.225	960	0.027	0.225	2265	0.020	0.225	3526	0.011
0.230	954	0.027	0.230	2250	0.020	0.230	3521	0.011
0.235	954	0.027	0.235	2234	0.020	0.235	3531	0.011
0.240	938	0.027	0.240	2211	0.020	0.240	3523	0.012
0.245	929	0.027	0.245	2180	0.020	0.245	3528	0.012
0.250	933	0.027	0.250	2172	0.020	0.250	3523	0.012
0.255	935	0.027	0.255	2155	0.020	0.255	3497	0.012
0.260	934	0.027	0.260	2150	0.020	0.260	3489	0.012
0.265	931	0.027	0.265	2160	0.020	0.265	3487	0.012
0.270	936	0.027	0.270	2158	0.020	0.270	3469	0.012
0.275	935	0.027	0.275	2156	0.020	0.275	3477	0.012
0.280	935	0.027	0.280	2166	0.020	0.280	3458	0.011
0.285	932	0.026	0.285	2164	0.020	0.285	3453	0.011
0.290	934	0.026	0.290	2155	0.020	0.290	3430	0.011
0.295	935	0.026	0.295	2155	0.020	0.295	3422	0.011
0.300	933	0.026	0.299	2158	0.020	0.295	3422	0.011

Consolidated Undrained Triaxial Compression Test for Cohesive Soils

(*ASTM D4767*)

Project: CS Mining - SW Pond
No: 01640-002 (II)
Location: Milford, UT
Date: 4/17/2013
By: NB

Boring No.: TP-24
Sample:
Depth: 3-4'
Sample Description: Brown silty sand
Engineering Classification: Not requested
Sample type: Laboratory compacted

	Test Number:	S1	S2	S3
Initial	Height, H (in)	5.973	5.983	5.981
	Diameter, D (in)	2.413	2.414	2.413
	Water content, w (%)	15.7	15.7	15.7
	Dry unit weight, γ_d (pcf)	112.6	112.4	112.6
	Saturation (%)	88.5	88.1	88.5
	Void ratio, e	0.47	0.47	0.47
	Mounting	Wet	Wet	Wet
Before shear	Water content, w (%)	16.6	16.9	16.4
	Dry unit weight, γ_d (pcf)	115.5	114.4	115.4
	Saturation[a] (%)	100.0	100.0	100.0
	Void ratio, e	0.43	0.45	0.43
	Area, A_{eoc} (in^2)	4.60	4.54	4.59
	Area method	A	A	A
	B	0.95	0.95	0.95
	t_{50} (min)	0.16	0.15	0.14
	Back pressure (psf)	6911	4751	6912
	Strain rate (%/min)	0.06	0.06	0.06
	Time to failure (min)	270.0	303.3	320.0
	Strain at failure, ε_f (%)	16.20	18.20	19.20
	Filter paper correction	No	No	No
	Membrane correction	Yes	Yes	Yes
Assumed specific gravity	2.65			

[a] Saturation set to 100% for phase calculations

Summary of strength parameters at peak deviator stress		
Total stress	c (psf)	2614
	ϕ (deg)	13.4
Effective stress	c' (psf)	443
	ϕ' (deg)	34.5

Comments:
Specimens were compacted to 95% of the MDUW at OWC +2%. The maximum dry unit weight and optimum water content obtained from the standard effort compaction test is 117.8 pcf and 13.7% respectively.

Tested by:__________

Reviewed:__________

Consolidated Undrained Triaxial Compression Test for Cohesive Soils

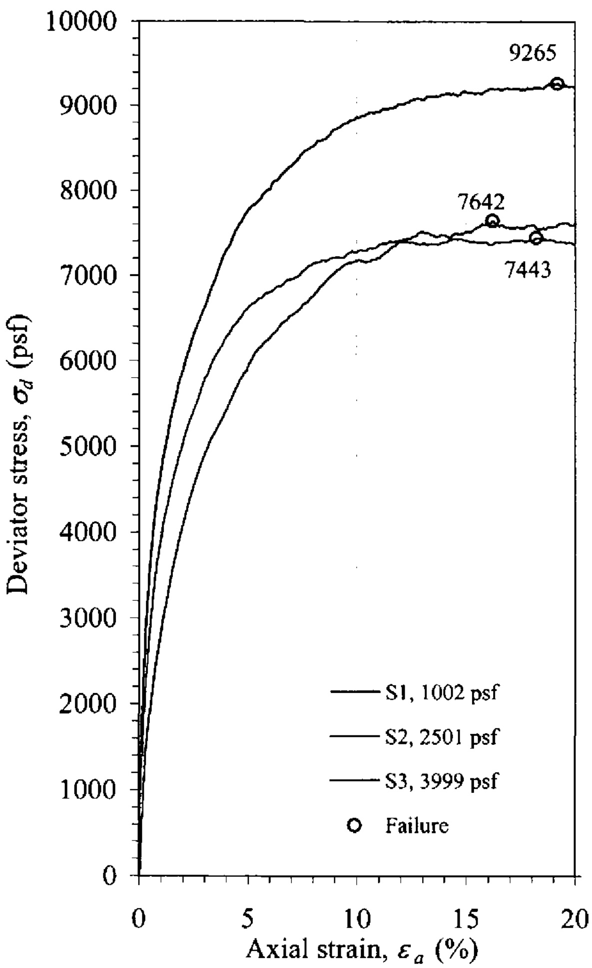
(*ASTM D4767*)

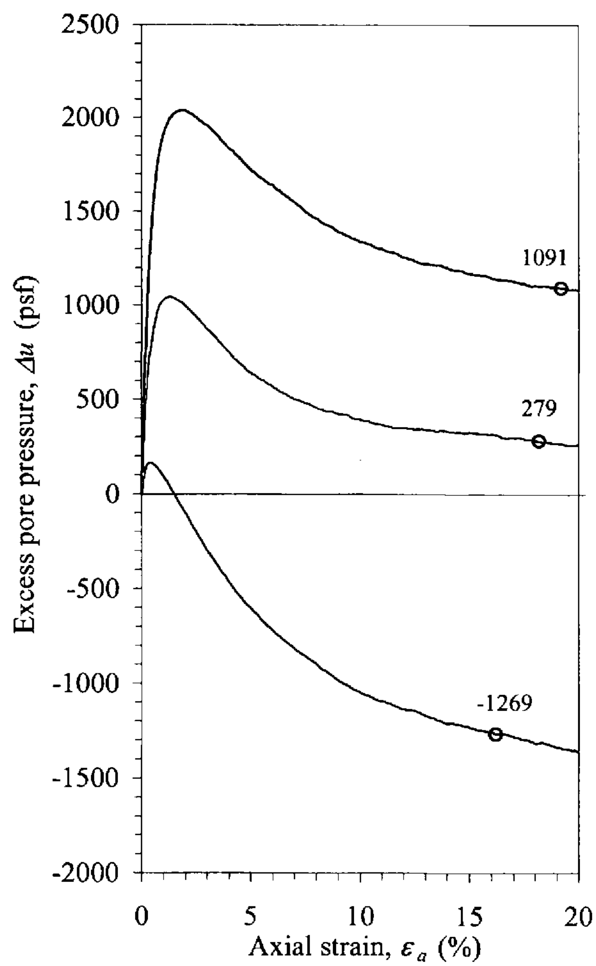
IGES

Project: CS Mining - SW Pond
No: 01640-002 (II)
Location: Milford, UT

Boring No.: TP-24
Sample:
Depth: 3-4'

	Test Number:	S1	S2	S3
Total stress	σ_3 (psf)	1002	2501	3999
	σ_1-σ_3 (psf)	7642	7443	9265
	σ_1 (psf)	8644	9944	13264
	$q = (\sigma_1 - \sigma_3)/2$ (psf)	3821	3722	4632
	$p = (\sigma_1 + \sigma_3)/2$ (psf)	4823	6222	8631
Effective stress	Δu (psf)	-1269	279	1091
	σ'_3 (psf)	2270	2222	2908
	σ'_1-σ'_3 (psf)	7642	7443	9265
	σ'_1 (psf)	9912	9665	12173
	$q = (\sigma'_1 - \sigma'_3)/2$ (psf)	3821	3722	4632
	$p' = (\sigma'_1 + \sigma'_3)/2$ (psf)	6091	5944	7541
	σ'_1/σ'_3	4.37	4.35	4.19
	$A = \Delta u/(\sigma_1 - \sigma_3)$	-0.166	0.037	0.118





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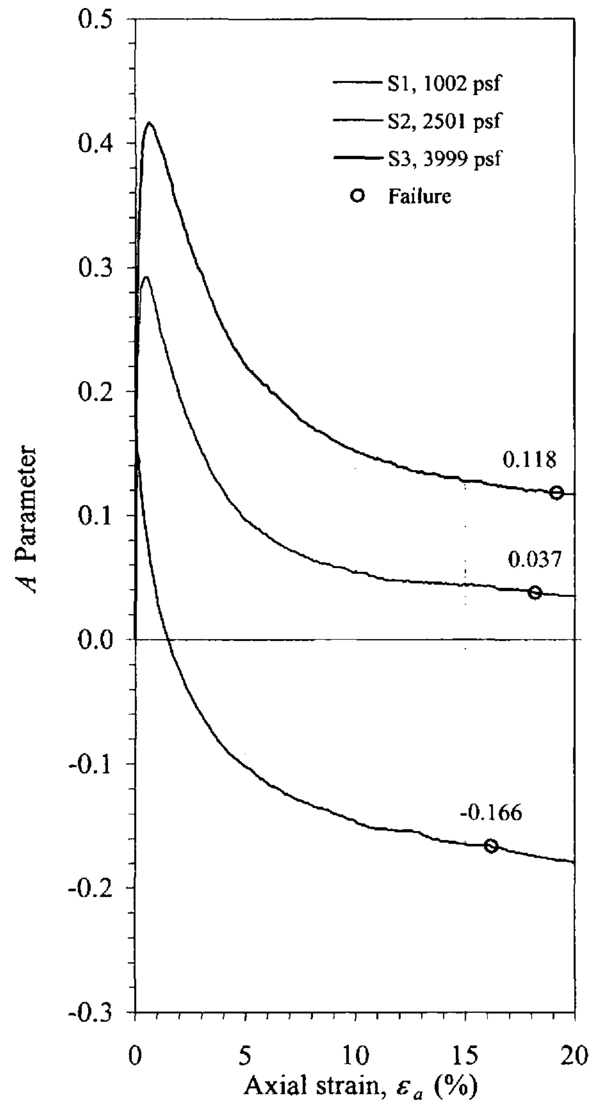
Consolidated Undrained Triaxial Compression Test for Cohesive Soils

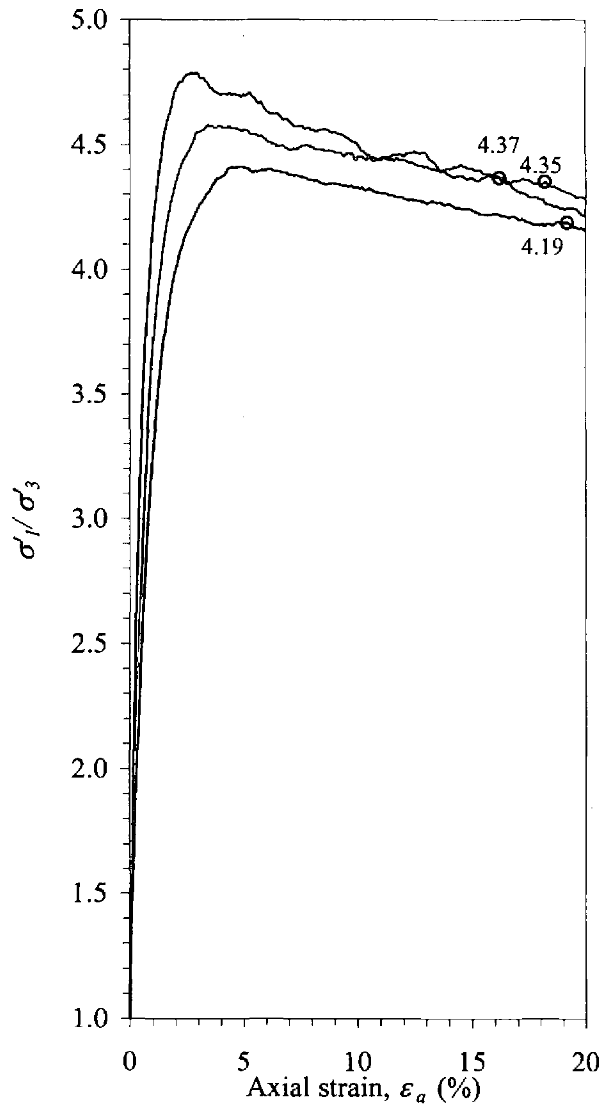
(ASTM D4767)

Project: CS Mining - SW Pond
No: 01640-002 (II)
Location: Milford, UT

Boring No.: TP-24
Sample:
Depth: 3-4'

Summary of strength parameters at peak deviator stress		
Total stress	c (psf)	2614
	ϕ (deg)	13.4
Effective stress	c' (psf)	443
	ϕ' (deg)	34.5





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Consolidated Undrained Triaxial Compression Test for Cohesive Soils

(ASTM D4767)

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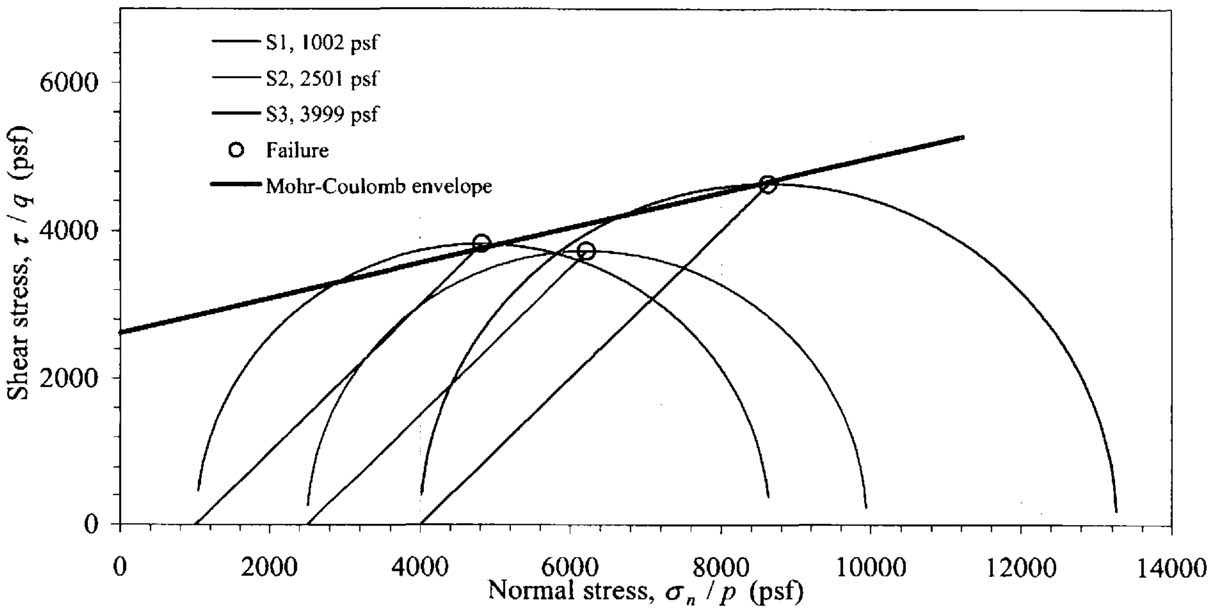
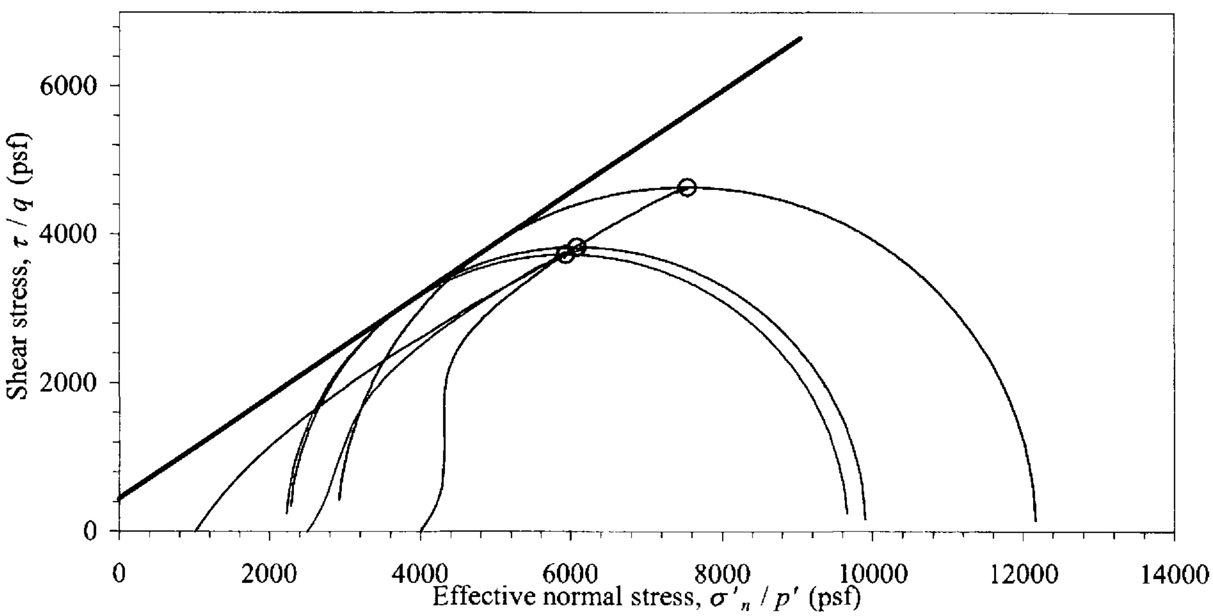
Project: CS Mining - SW Pond
No: 01640-002 (II)
Location: Milford, UT

Boring No.: TP-24
Sample:
Depth: 3-4'

Summary of strength parameters at peak deviator stress		
Total stress	*c* (psf)	2614
	ϕ (deg)	13.4
Effective stress	*c'* (psf)	443
	ϕ' (deg)	34.5





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Water Content and Unit Weight of Soil

(In General Accordance with ASTM D7263 Method B and D2216)

IGES

Project: CS Mining - SE Pond
No: 01640-002 (III)
Location: Milford, UT
Date: 8/28/2013
By: JDF

Sample Info.	Boring No.	TP41	TP42	TP42	TP43	TP43	TP44	TP44	TP46
	Sample								
	Depth	4-6'	2-3'	5-6'	2-3'	6-8'	2-3'	5'	3-4'
	Split	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No
	Split sieve	3/8"	3/4"	3/8"	3/4"	3/8"	3/4"	3/4"	
	Total sample (g)	28171.62	33132.40	32011.10	31813.20	29942.80	28972.78	31651.42	
	Moist coarse fraction (g)	249.22	3033.00	2384.60	2567.00	4194.20	778.08	858.82	
	Moist split fraction (g)	27922.40	30099.40	29626.50	29246.20	25748.60	28194.70	30792.60	
	Sample height, H (in)								
	Sample diameter, D (in)								
	Mass rings + wet soil (g)								
	Mass rings/tare (g)								
	Moist unit wt., γ_m (pcf)								
Coarse Fraction	Wet soil + tare (g)	428.59	1046.79	816.78	801.97	2744.96	1051.24	1251.13	
	Dry soil + tare (g)	425.75	1041.67	810.76	798.97	2728.91	1045.60	1245.96	
	Tare (g)	179.40	225.12	179.21	179.75	409.84	273.26	319.12	
	Water content (%)	1.2	0.6	1.0	0.5	0.7	0.7	0.6	
Split Fraction	Wet soil + tare (g)	1855.60	2276.66	2015.28	1688.37	1618.46	1848.81	1923.49	1047.26
	Dry soil + tare (g)	1751.49	2241.30	1978.01	1658.74	1576.71	1819.28	1867.28	936.59
	Tare (g)	310.20	410.43	330.91	408.93	312.14	465.81	391.19	311.05
	Water content (%)	7.2	1.9	2.3	2.4	3.3	2.2	3.8	17.7
	Water Content, w (%)	7.2	**1.8**	2.2	**2.2**	2.9	**2.1**	3.7	**17.7**
	Dry Unit Wt., γ_d (pcf)								

Entered by:__________
Reviewed:__________

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Water Content and Unit Weight of Soil

(In General Accordance with ASTM D7263 Method B and D2216)

Project: CS Mining - SE Pond
No: 01640-002 (III)
Location: Milford, UT
Date: 8/28/2013
By: JDF

Sample Info.	Boring No.	TP49	TP51	TP52	TP53	TP55			
	Sample								
	Depth	4-6'	4-5'	4-5'	3-4'	3-4'			
	Split	Yes	Yes	Yes	No	Yes			
	Split sieve	3/8"	3/8"	3/8"		3/8"			
	Total sample (g)	28216.48	31985.16	33957.90		4634.01			
	Moist coarse fraction (g)	731.08	2652.86	3997.70		816.03			
	Moist split fraction (g)	27485.40	29332.30	29960.20		3817.98			
	Sample height, H (in)								
	Sample diameter, D (in)								
	Mass rings + wet soil (g)								
	Mass rings/tare (g)								
	Moist unit wt., γ_m (pcf)								
Coarse Fraction	Wet soil + tare (g)	1030.56	723.44	2383.54		1035.41			
	Dry soil + tare (g)	1021.43	720.30	2363.13		1029.10			
	Tare (g)	299.58	225.62	328.97		219.42			
	Water content (%)	1.3	0.6	1.0		0.8			
Split Fraction	Wet soil + tare (g)	1952.00	2279.80	1779.56	2845.69	1307.72			
	Dry soil + tare (g)	1868.70	2244.73	1738.66	2784.81	1288.62			
	Tare (g)	446.70	310.60	331.46	312.84	333.16			
	Water content (%)	5.9	1.8	2.9	2.5	2.0			
	Water Content, w (%)	5.7	1.7	2.7	2.5	1.8			
	Dry Unit Wt., γ_d (pcf)								

Entered by:___________

Reviewed:___________

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Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis

(ASTM D6913)

IGES

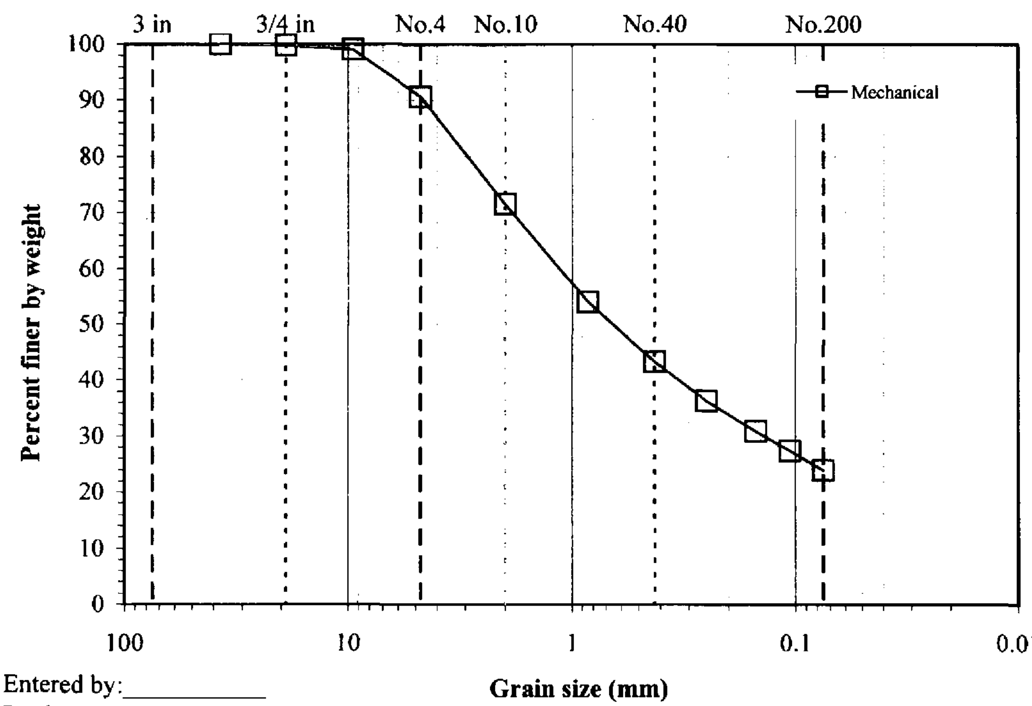
Project: CS Mining - SE Pond
No: 01640-002 (III)
Location: Milford, UT
Date: 8/27/2013
By: JDF/ET

Boring No.: TP41
Sample:
Depth: 4-6'
Description: Light brown clayey sand

Split:	Yes	
Split sieve:	3/8"	
	Moist	Dry
Total sample wt. (g):	28174.62	26290.51
+3/8" Coarse fraction (g):	249.22	246.38
-3/8" Split fraction (g):	1545.40	1441.29
Split fraction:	0.991	

Water content data	C.F.(+3/8")	S.F.(-3/8")
Moist soil + tare (g):	428.59	1855.60
Dry soil + tare (g):	425.75	1751.49
Tare (g):	179.40	310.20
Water content (%):	1.2	7.2

Sieve	Accum. Wt. Ret. (g)	Grain Size (mm)	Percent Finer
8"	-	200	-
6"	-	150	-
4"	-	100	-
3"	-	75	-
1.5"	-	37.5	100.0
3/4"	62.88	19	99.8
3/8"	246.38	9.5	99.1 ←Split
No.4	123.20	4.75	90.6
No.10	401.44	2	71.5
No.20	656.07	0.85	54.0
No.40	813.13	0.425	43.2
No.60	913.91	0.25	36.2
No.100	992.49	0.15	30.8
No.140	1043.52	0.106	27.3
No.200	1094.42	0.075	23.8



Gravel (%): 9.4
Sand (%): 66.8
Fines (%): 23.8

Entered by:____________
Reviewed:____________

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Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis

(ASTM D6913)

IGES

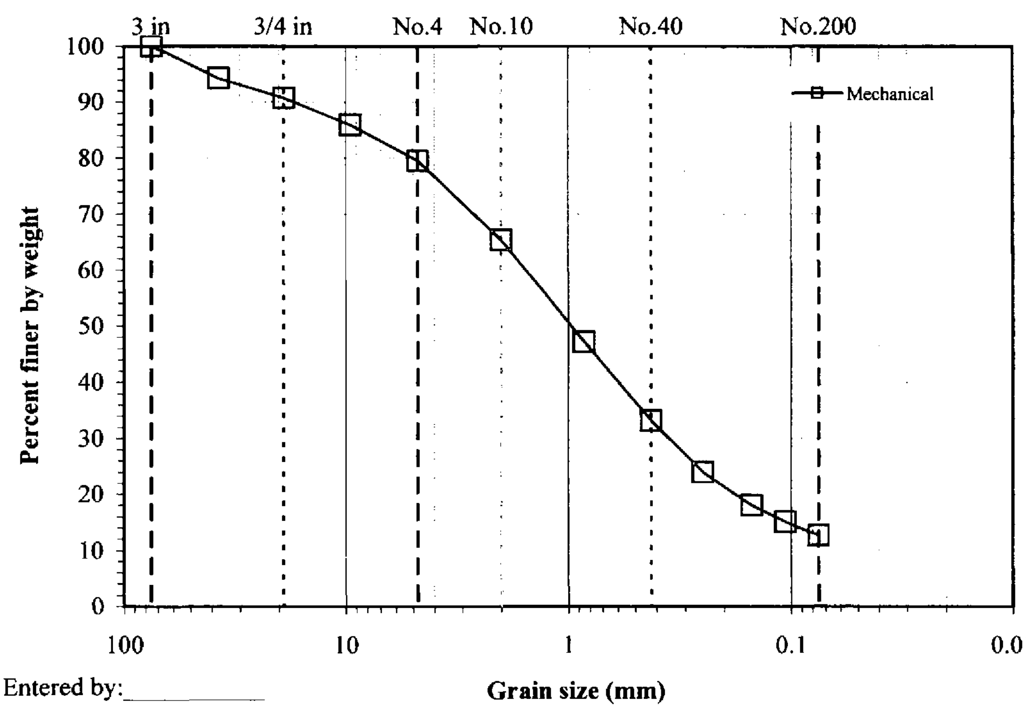
Project: CS Mining - SE Pond
No: 01640-002 (III)
Location: Milford, UT
Date: 8/27/2013
By: JDF/ET

Boring No.: TP42
Sample:
Depth: 2-3'
Description: Light brown silty sand with gravel

Split:	Yes	
Split sieve:	3/4"	
	Moist	Dry
Total sample wt. (g):	33132.40	32543.20
+3/4" Coarse fraction (g):	3033.00	3014.10
-3/4" Split fraction (g):	1866.23	1830.87
Split fraction:	0.907	

Water content data	C.F.(+3/4")	S.F.(-3/4")
Moist soil + tare (g):	1046.79	2276.66
Dry soil + tare (g):	1041.67	2241.30
Tare (g):	225.12	410.43
Water content (%):	0.6	1.9

Sieve	Accum. Wt. Ret. (g)	Grain Size (mm)	Percent Finer	
8"	-	200	-	
6"	-	150	-	
4"	-	100	-	
3"	-	75	100.0	
1.5"	1873.25	37.5	94.2	
3/4"	3014.10	19	90.7	←Split
3/8"	98.52	9.5	85.9	
No.4	228.92	4.75	79.4	
No.10	513.48	2	65.3	
No.20	879.01	0.85	47.2	
No.40	1162.18	0.425	33.1	
No.60	1346.65	0.25	24.0	
No.100	1467.00	0.15	18.0	
No.140	1526.67	0.106	15.1	
No.200	1575.06	0.075	12.7	



Gravel (%): 20.6
Sand (%): 66.7
Fines (%): 12.7

Entered by:__________
Reviewed:__________

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Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis

(ASTM D6913)

IGES

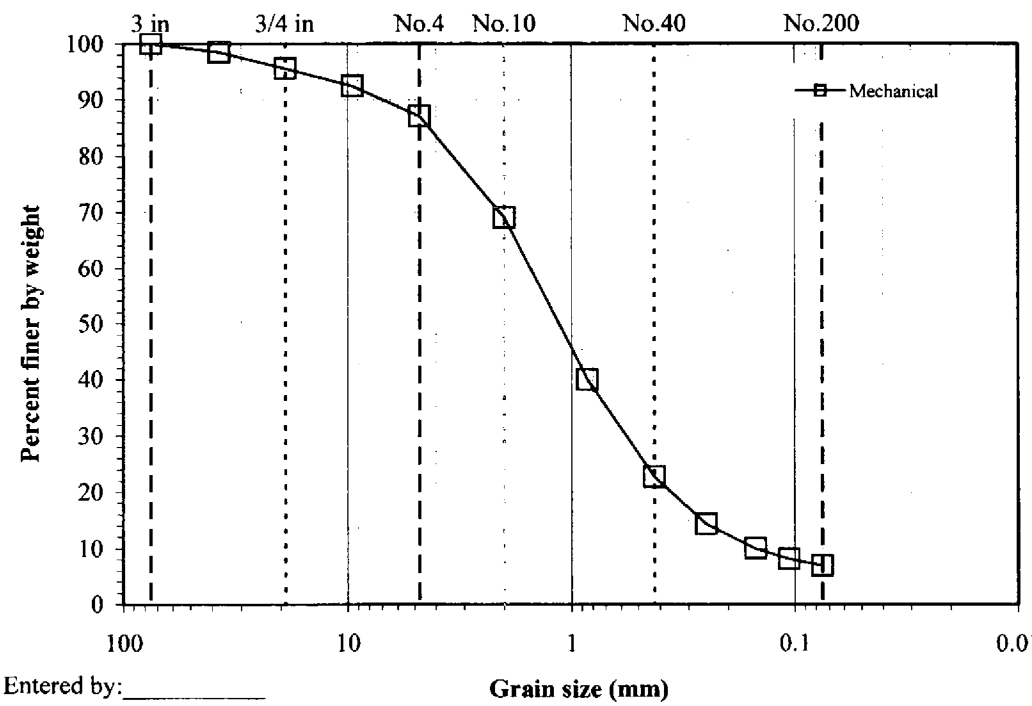
Project: CS Mining - SE Pond
No: 01640-002 (III)
Location: Milford, UT
Date: 8/27/2013
By: JDF/ET

Boring No.: TP42
Sample:
Depth: 5-6'
Description: Light brown sand with silt

Split:	Yes	
Split sieve:	3/8"	
	Moist	Dry
Total sample wt. (g):	32011.10	31333.04
+3/8" Coarse fraction (g):	2384.60	2362.08
-3/8" Split fraction (g):	1684.37	1647.10
Split fraction:	0.925	

Water content data	C.F.(+3/8")	S.F.(-3/8")
Moist soil + tare (g):	816.78	2015.28
Dry soil + tare (g):	810.76	1978.01
Tare (g):	179.21	330.91
Water content (%):	1.0	2.3

Sieve	Accum. Wt. Ret. (g)	Grain Size (mm)	Percent Finer	
8"	-	200	-	
6"	-	150	-	
4"	-	100	-	
3"	-	75	100.0	
1.5"	473.98	37.5	98.5	
3/4"	1404.02	19	95.5	
3/8"	2362.08	9.5	92.5	←Split
No.4	95.61	4.75	87.1	
No.10	418.19	2	69.0	
No.20	933.00	0.85	40.1	
No.40	1241.06	0.425	22.8	
No.60	1392.37	0.25	14.3	
No.100	1470.43	0.15	9.9	
No.140	1503.39	0.106	8.1	
No.200	1524.99	0.075	6.9	



Gravel (%): 12.9
Sand (%): 80.2
Fines (%): 6.9

Entered by:__________
Reviewed:__________

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Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis

(ASTM D6913)

IGES

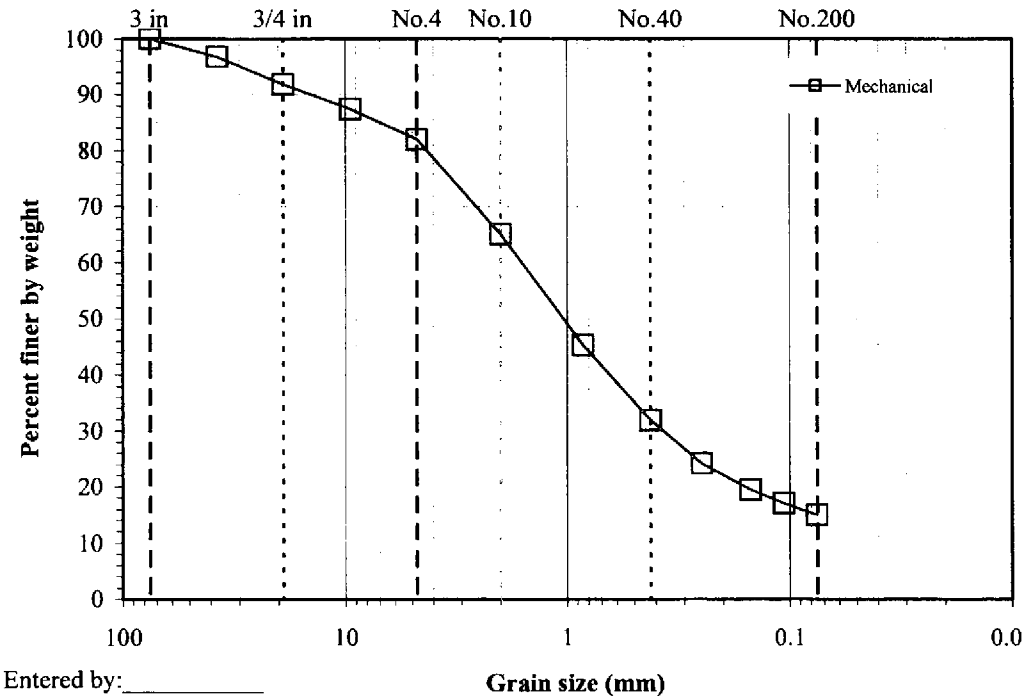
Project: CS Mining - SE Pond
No: 01640-002 (III)
Location: Milford, UT
Date: 8/27/2013
By: JDF/ET

Boring No.: TP43
Sample:
Depth: 2-3'
Description: Light brown silty sand with gravel

Split:	Yes	
Split sieve:	3/4"	
	Moist	Dry
Total sample wt. (g):	31813.20	31123.52
+3/4" Coarse fraction (g):	2567.00	2554.62
-3/4" Split fraction (g):	1279.44	1249.81
Split fraction:	0.918	

Water content data	C.F.(+3/4")	S.F.(-3/4")
Moist soil + tare (g):	801.97	1688.37
Dry soil + tare (g):	798.97	1658.74
Tare (g):	179.75	408.93
Water content (%):	0.5	2.4

Sieve	Accum. Wt. Ret. (g)	Grain Size (mm)	Percent Finer	
8"	-	200	-	
6"	-	150	-	
4"	-	100	-	
3"	-	75	100.0	
1.5"	1026.13	37.5	96.7	
3/4"	2554.62	19	91.8	←Split
3/8"	58.90	9.5	87.5	
No.4	134.06	4.75	81.9	
No.10	365.26	2	65.0	
No.20	633.78	0.85	45.2	
No.40	814.36	0.425	32.0	
No.60	921.07	0.25	24.1	
No.100	984.60	0.15	19.5	
No.140	1017.92	0.106	17.0	
No.200	1045.65	0.075	15.0	



Gravel (%): 18.1
Sand (%): 67.0
Fines (%): 15.0

Entered by:___________
Reviewed:___________

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Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis

(ASTM D6913)

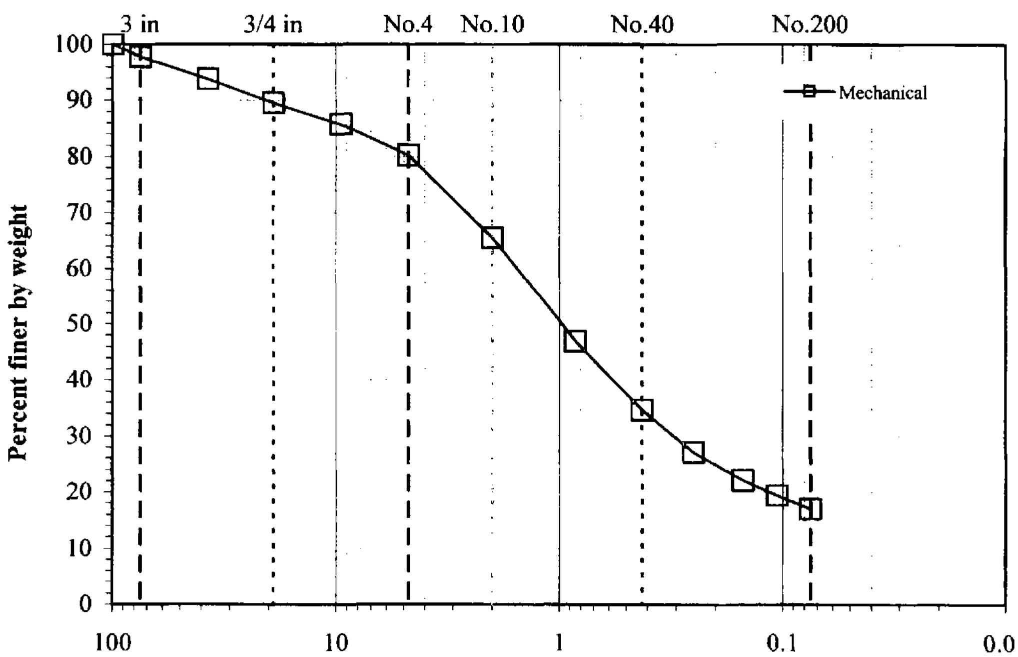
Project: CS Mining - SE Pond
No: 01640-002 (III)
Location: Milford, UT
Date: 8/27/2013
By: JDF/ET

Boring No.: TP43
Sample:
Depth: 6-8'
Description: Light brown silty sand with gravel

Split:	Yes	
Split sieve:	3/8"	
	Moist	Dry
Total sample wt. (g):	29942.80	29091.05
+3/8" Coarse fraction (g):	4194.20	4165.37
-3/8" Split fraction (g):	1306.32	1264.57
Split fraction:	0.857	

Water content data	C.F.(+3/8")	S.F.(-3/8")
Moist soil + tare (g):	2744.96	1618.46
Dry soil + tare (g):	2728.91	1576.71
Tare (g):	409.84	312.14
Water content (%):	0.7	3.3

Sieve	Accum. Wt. Ret. (g)	Grain Size (mm)	Percent Finer	
8"	-	200	-	
6"	-	150	-	
4"	-	100	100.0	
3"	654.37	75	97.8	
1.5"	1806.80	37.5	93.8	
3/4"	3056.45	19	89.5	
3/8"	4165.37	9.5	85.7	←Split
No.4	81.53	4.75	80.2	
No.10	298.10	2	65.5	
No.20	571.41	0.85	47.0	
No.40	752.50	0.425	34.7	
No.60	864.69	0.25	27.1	
No.100	938.58	0.15	22.1	
No.140	979.04	0.106	19.3	
No.200	1014.73	0.075	16.9	



Gravel (%): 19.8
Sand (%): 63.2
Fines (%): 16.9

Entered by:__________
Reviewed:__________

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Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis

(ASTM D6913)

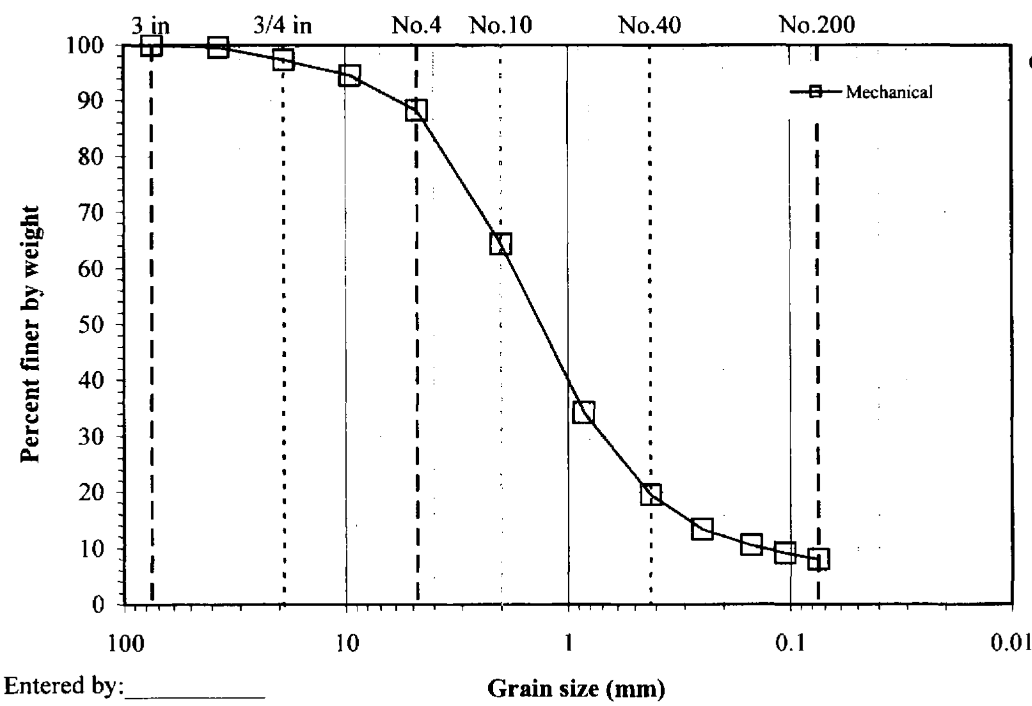
Project: CS Mining - SE Pond
No: 01640-002 (III)
Location: Milford, UT
Date: 8/27/2013
By: JDF/ET

Boring No.: TP44
Sample:
Depth: 2-3'
Description: Brown sand with silt

	Moist	Dry
Split:	Yes	
Split sieve:	3/4"	
Total sample wt. (g):	28972.78	28365.41
+3/4" Coarse fraction (g):	778.08	772.44
-3/4" Split fraction (g):	1383.66	1354.13
Split fraction:	0.973	

Water content data	C.F.(+3/4")	S.F.(-3/4")
Moist soil + tare (g):	1051.24	1848.81
Dry soil + tare (g):	1045.60	1819.28
Tare (g):	273.26	465.15
Water content (%):	0.7	2.2

Sieve	Accum. Wt. Ret. (g)	Grain Size (mm)	Percent Finer	
8"	-	200	-	
6"	-	150	-	
4"	-	100	-	
3"	-	75	100.0	
1.5"	134.31	37.5	99.5	
3/4"	772.44	19	97.3	←Split
3/8"	37.60	9.5	94.6	
No.4	126.54	4.75	88.2	
No.10	458.52	2	64.3	
No.20	877.71	0.85	34.2	
No.40	1082.83	0.425	19.5	
No.60	1168.13	0.25	13.4	
No.100	1207.77	0.15	10.5	
No.140	1227.85	0.106	9.1	
No.200	1242.53	0.075	8.0	



Gravel (%): 11.8
Sand (%): 80.2
Fines (%): 8.0

Entered by:___________
Reviewed:___________

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Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis

(ASTM D6913)

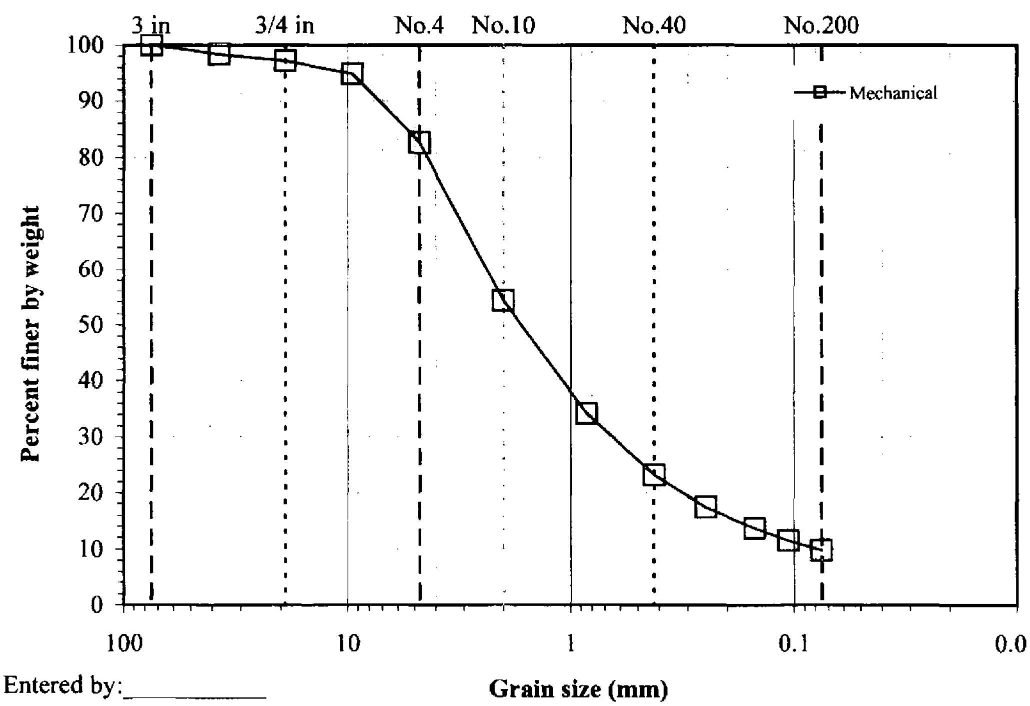
Project: CS Mining - SE Pond
No: 01640-002 (III)
Location: Milford, UT
Date: 8/27/2013
By: JDF/ET

Boring No.: TP44
Sample:
Depth: 5.0'
Description: Light brown sand with clay and gravel

Split:	Yes	
Split sieve:	3/4"	
	Moist	Dry
Total sample wt. (g):	31651.42	30517.08
+3/4" Coarse fraction (g):	858.82	854.06
-3/4" Split fraction (g):	1532.30	1476.09
Split fraction:	0.972	

Water content data	C.F.(+3/4")	S.F.(-3/4")
Moist soil + tare (g):	1251.13	1923.49
Dry soil + tare (g):	1245.96	1867.28
Tare (g):	319.12	391.19
Water content (%):	0.6	3.8

Sieve	Accum. Wt. Ret. (g)	Grain Size (mm)	Percent Finer	
8"	-	200	-	
6"	-	150	-	
4"	-	100	-	
3"	-	75	100.0	
1.5"	516.66	37.5	98.3	
3/4"	854.06	19	97.2	←Split
3/8"	34.89	9.5	94.9	
No.4	221.50	4.75	82.6	
No.10	652.16	2	54.3	
No.20	957.37	0.85	34.2	
No.40	1123.94	0.425	23.2	
No.60	1211.72	0.25	17.4	
No.100	1267.92	0.15	13.7	
No.140	1300.88	0.106	11.5	
No.200	1328.94	0.075	9.7	



Gravel (%): 17.4
Sand (%): 72.9
Fines (%): 9.7

Entered by:__________
Reviewed:__________

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Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis

(ASTM D6913)

IGES

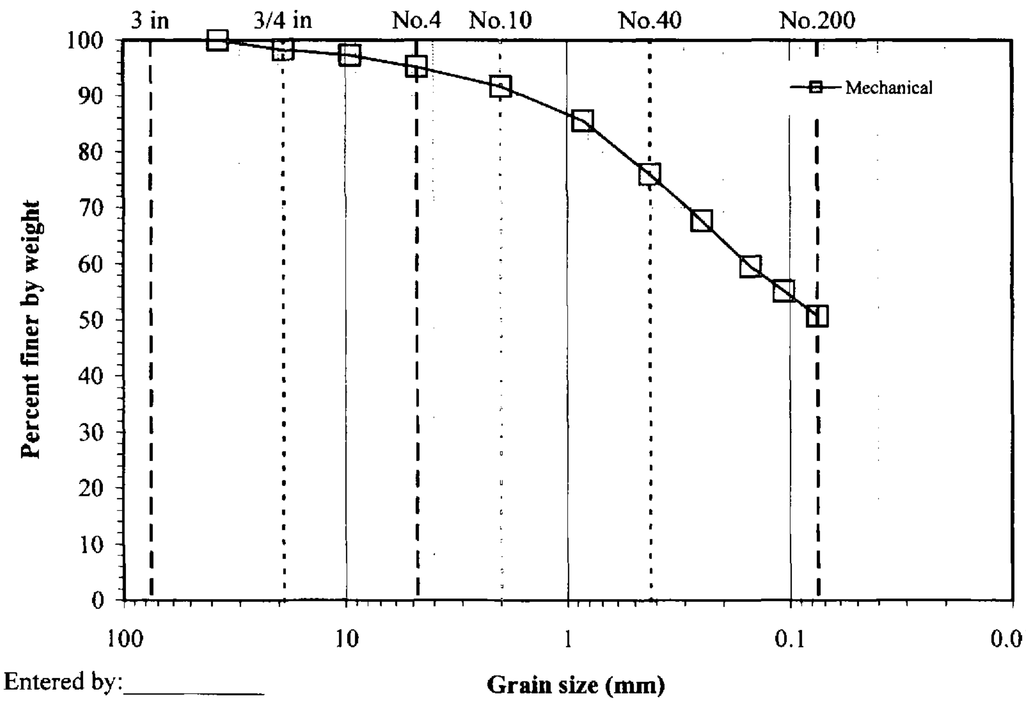
Project: CS Mining - SE Pond
No: 01640-002 (III)
Location: Milford, UT
Date: 8/27/2013
By: JDF/ET

Boring No.: TP46
Sample:
Depth: 3-4'
Description: Light brown sandy silt

Split:	No	
	Moist	Dry
Total sample wt. (g):	736.21	625.54
Split fraction:	1.000	

Water content data		
Moist soil + tare (g):	-	1047.26
Dry soil + tare (g):	-	936.59
Tare (g):	-	311.05
Water content (%):	0.0	17.7

Sieve	Accum. Wt. Ret. (g)	Grain Size (mm)	Percent Finer
8"	-	200	-
6"	-	150	-
4"	-	100	-
3"	-	75	-
1.5"	-	37.5	100.0
3/4"	10.96	19	98.2
3/8"	16.93	9.5	97.3
No.4	30.42	4.75	95.1
No.10	51.68	2	91.7
No.20	90.29	0.85	85.6
No.40	150.55	0.425	75.9
No.60	202.80	0.25	67.6
No.100	253.47	0.15	59.5
No.140	280.87	0.106	55.1
No.200	308.46	0.075	50.7



Gravel (%): 4.9
Sand (%): 44.4
Fines (%): 50.7

Entered by:__________
Reviewed:__________

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Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis

(ASTM D6913)

IGES

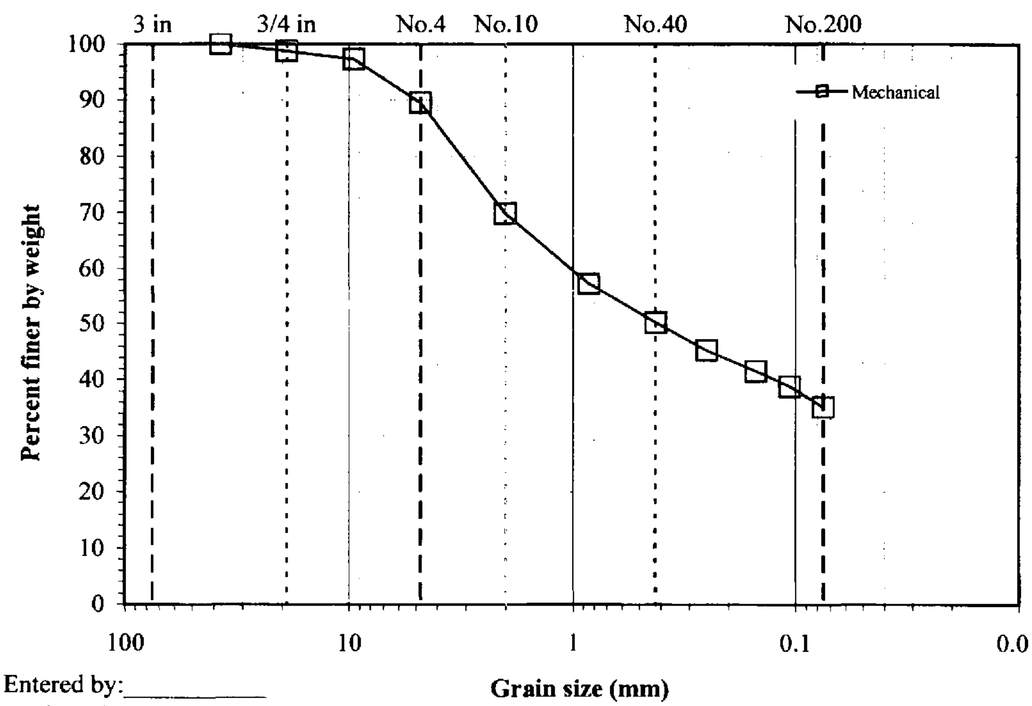
Project: CS Mining - SE Pond
No: 01640-002 (III)
Location: Milford, UT
Date: 8/27/2013
By: JDF/ET

Boring No.: TP49
Sample:
Depth: 4-6'
Description: Brown silty sand

Split:	Yes	
Split sieve:	3/8"	
	Moist	Dry
Total sample wt. (g):	28216.48	26686.37
+3/8" Coarse fraction (g):	731.08	721.95
-3/8" Split fraction (g):	1505.30	1422.00
Split fraction:	0.973	

Water content data	C.F.(+3/8")	S.F.(-3/8")
Moist soil + tare (g):	1030.56	1952.00
Dry soil + tare (g):	1021.43	1868.70
Tare (g):	299.58	446.70
Water content (%):	1.3	5.9

Sieve	Accum. Wt. Ret. (g)	Grain Size (mm)	Percent Finer	
8"	-	200	-	
6"	-	150	-	
4"	-	100	-	
3"	-	75	-	
1.5"	-	37.5	100.0	
3/4"	357.55	19	98.7	
3/8"	721.95	9.5	97.3	←Split
No.4	113.76	4.75	89.5	
No.10	402.19	2	69.8	
No.20	584.94	0.85	57.3	
No.40	687.62	0.425	50.2	
No.60	760.03	0.25	45.3	
No.100	814.21	0.15	41.6	
No.140	853.75	0.106	38.9	
No.200	909.30	0.075	35.1	



Gravel (%): 10.5
Sand (%): 54.4
Fines (%): 35.1

Entered by:__________

Reviewed:__________

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Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis

(ASTM D6913)

IGES

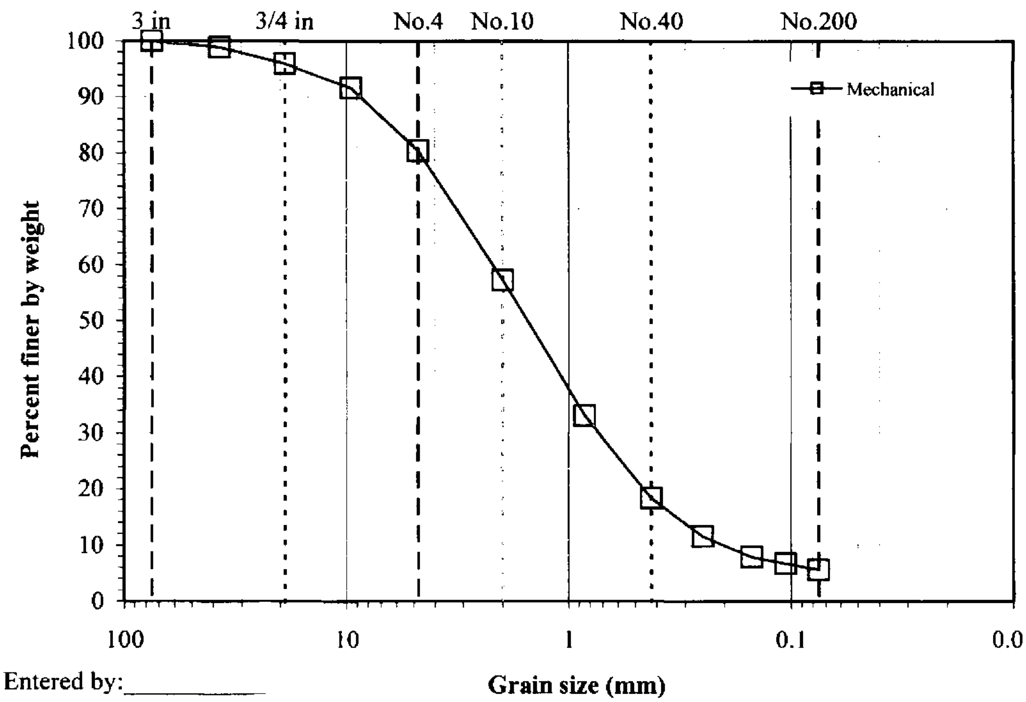
Project: CS Mining - SE Pond
No: 01640-002 (III)
Location: Milford, UT
Date: 8/27/2013
By: JDF/ET

Boring No.: TP51
Sample:
Depth: 4-5'
Description: Brown sand with silt and gravel

Split:	Yes	
Split sieve:	3/8"	
	Moist	Dry
Total sample wt. (g):	31985.16	31445.98
+3/8" Coarse fraction (g):	2652.86	2636.13
-3/8" Split fraction (g):	1968.96	1933.89
Split fraction:	0.916	

Water content data	C.F.(+3/8")	S.F.(-3/8")
Moist soil + tare (g):	723.44	2279.80
Dry soil + tare (g):	720.30	2244.73
Tare (g):	225.62	310.84
Water content (%):	0.6	1.8

Sieve	Accum. Wt. Ret. (g)	Grain Size (mm)	Percent Finer	
8"	-	200	-	
6"	-	150	-	
4"	-	100	-	
3"	-	75	100.0	
1.5"	366.37	37.5	98.8	
3/4"	1312.50	19	95.8	
3/8"	2636.13	9.5	91.6	←Split
No.4	238.56	4.75	80.3	
No.10	726.86	2	57.2	
No.20	1236.13	0.85	33.1	
No.40	1546.70	0.425	18.3	
No.60	1689.70	0.25	11.6	
No.100	1767.00	0.15	7.9	
No.140	1793.90	0.106	6.6	
No.200	1816.40	0.075	5.6	



Gravel (%): 19.7
Sand (%): 74.7
Fines (%): 5.6

Entered by:__________
Reviewed:__________

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Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis

(ASTM D6913)

IGES

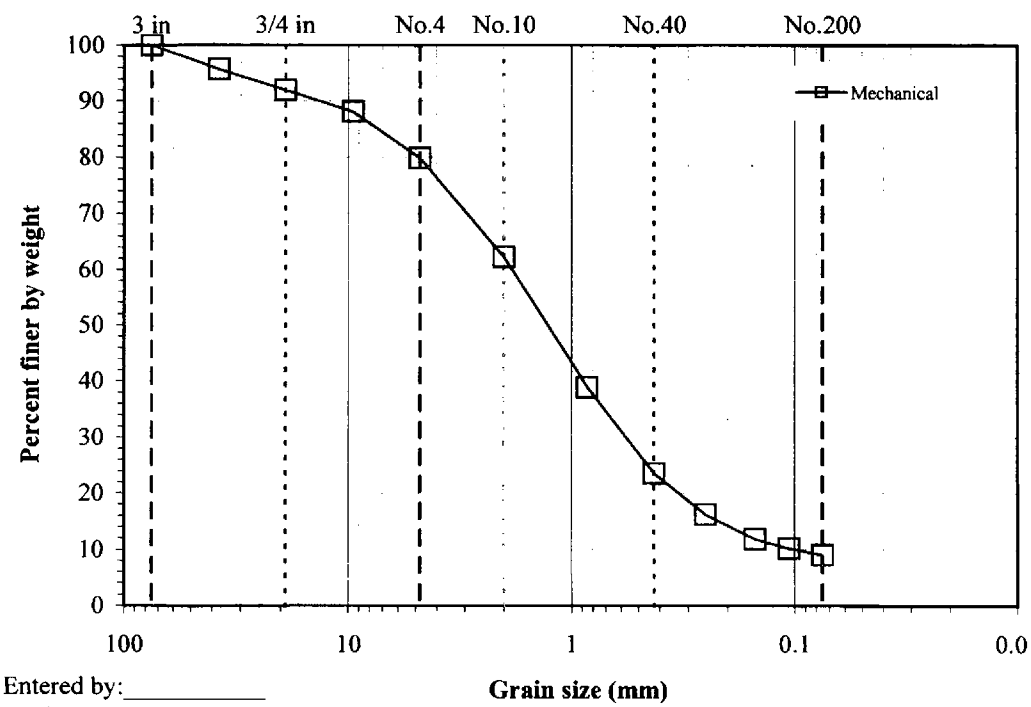
Project: CS Mining - SE Pond
No: 01640-002 (III)
Location: Milford, UT
Date: 8/27/2013
By: JDF/ET

Boring No.: TP52
Sample:
Depth: 4-5'
Description: Light brown sand with silt and gravel

Split:	Yes	
Split sieve:	3/8"	
	Moist	Dry
Total sample wt. (g):	33957.90	33071.99
+3/8" Coarse fraction (g):	3997.70	3957.99
-3/8" Split fraction (g):	1448.10	1407.20
Split fraction:	0.880	

Water content data	C.F.(+3/8")	S.F.(-3/8")
Moist soil + tare (g):	2383.54	1779.56
Dry soil + tare (g):	2363.13	1738.66
Tare (g):	328.97	331.46
Water content (%):	1.0	2.9

Sieve	Accum. Wt. Ret. (g)	Grain Size (mm)	Percent Finer	
8"	-	200	-	
6"	-	150	-	
4"	-	100	-	
3"	-	75	100.0	
1.5"	1436.52	37.5	95.7	
3/4"	2670.71	19	91.9	
3/8"	3957.99	9.5	88.0	←Split
No.4	132.33	4.75	79.8	
No.10	412.19	2	62.2	
No.20	786.61	0.85	38.8	
No.40	1030.68	0.425	23.6	
No.60	1149.10	0.25	16.1	
No.100	1218.75	0.15	11.8	
No.140	1243.68	0.106	10.2	
No.200	1264.14	0.075	8.9	



Gravel (%): 20.2
Sand (%): 70.8
Fines (%): 8.9

Entered by:___________
Reviewed:___________

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Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis

(ASTM D6913)

IGES

Project: CS Mining - SE Pond
No: 01640-002 (III)
Location: Milford, UT
Date: 8/27/2013
By: JDF/ET

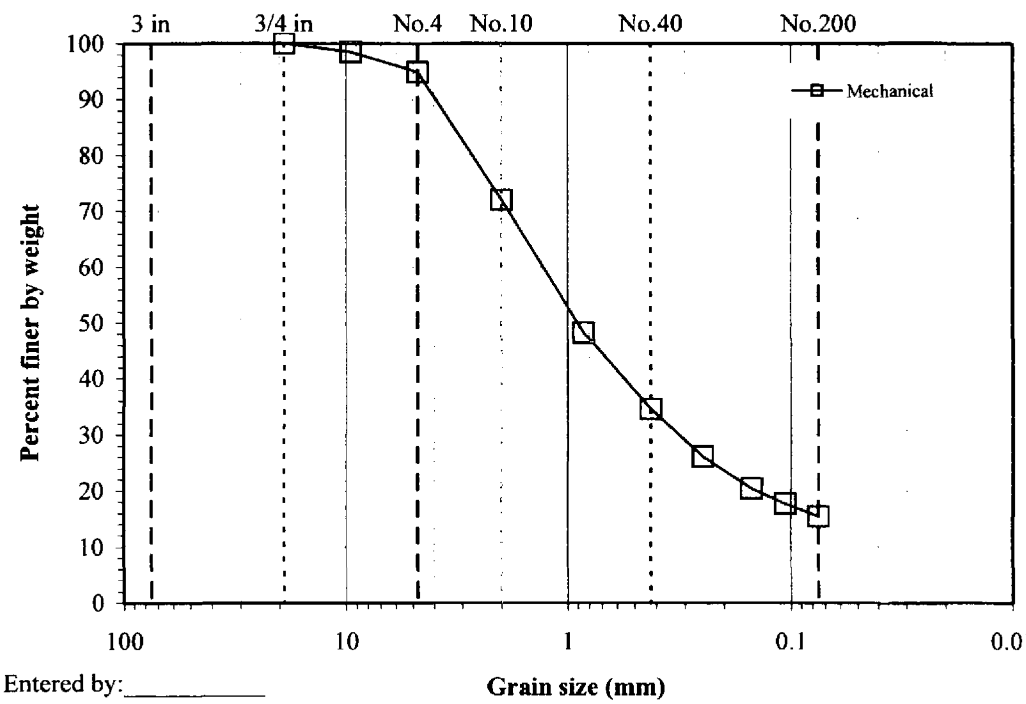
Boring No.: TP53
Sample:
Depth: 3-4'
Description: Brown silty sand

Split:	No	
	Moist	Dry
Total sample wt. (g):	2532.85	2471.97
Split fraction:	1.000	

Water content data

Moist soil + tare (g):	-	2845.69
Dry soil + tare (g):	-	2784.81
Tare (g):	-	312.84
Water content (%):	0.0	2.5

Sieve	Accum. Wt. Ret. (g)	Grain Size (mm)	Percent Finer
8"	-	200	-
6"	-	150	-
4"	-	100	-
3"	-	75	-
1.5"	-	37.5	-
3/4"	-	19	100.0
3/8"	38.02	9.5	98.5
No.4	127.34	4.75	94.8
No.10	692.71	2	72.0
No.20	1279.50	0.85	48.2
No.40	1618.59	0.425	34.5
No.60	1825.92	0.25	26.1
No.100	1967.33	0.15	20.4
No.140	2034.26	0.106	17.7
No.200	2089.64	0.075	15.5



Gravel (%): 5.2
Sand (%): 79.4
Fines (%): 15.5

Entered by:__________
Reviewed:__________

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Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis

(ASTM D6913)

IGES

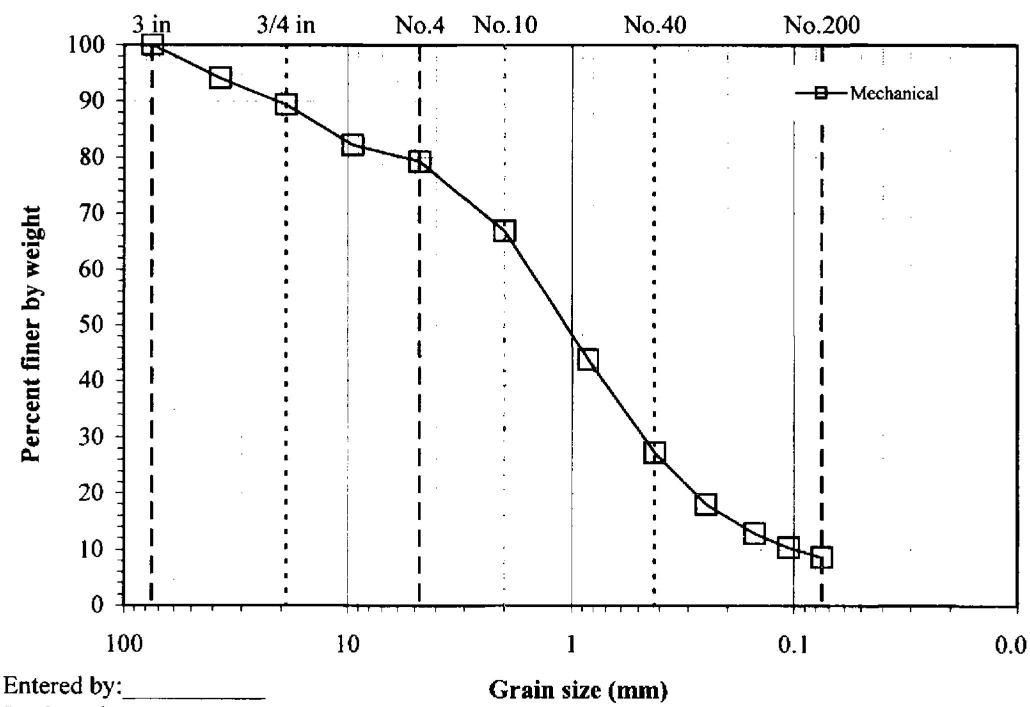
Project: CS Mining - SE Pond
No: 01640-002 (III)
Location: Milford, UT
Date: 8/27/2013
By: JDF/ET

Boring No.: TP55
Sample:
Depth: 3-4'
Description: Brown sand with silt and gravel

Split:	Yes	
Split sieve:	3/8"	
	Moist	Dry
Total sample wt. (g):	4634.01	4552.87
+3/8" Coarse fraction (g):	816.03	809.72
-3/8" Split fraction (g):	974.56	955.46
Split fraction:	0.822	

Water content data	C.F.(+3/8")	S.F.(-3/8")
Moist soil + tare (g):	1035.41	1307.72
Dry soil + tare (g):	1029.10	1288.62
Tare (g):	219.42	333.16
Water content (%):	0.8	2.0

Sieve	Accum. Wt. Ret. (g)	Grain Size (mm)	Percent Finer	
8"	-	200	-	
6"	-	150	-	
4"	-	100	-	
3"	-	75	100.0	
1.5"	267.45	37.5	94.1	
3/4"	482.97	19	89.4	
3/8"	809.72	9.5	82.2	←Split
No.4	34.63	4.75	79.2	
No.10	179.20	2	66.8	
No.20	446.54	0.85	43.8	
No.40	638.65	0.425	27.3	
No.60	745.77	0.25	18.0	
No.100	805.92	0.15	12.9	
No.140	834.82	0.106	10.4	
No.200	854.82	0.075	8.7	



Gravel (%): 20.8
Sand (%): 70.6
Fines (%): 8.7

Entered by:__________
Reviewed:__________

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Laboratory Compaction Characteristics of Soil

(ASTM D698 / D1557)

IGES

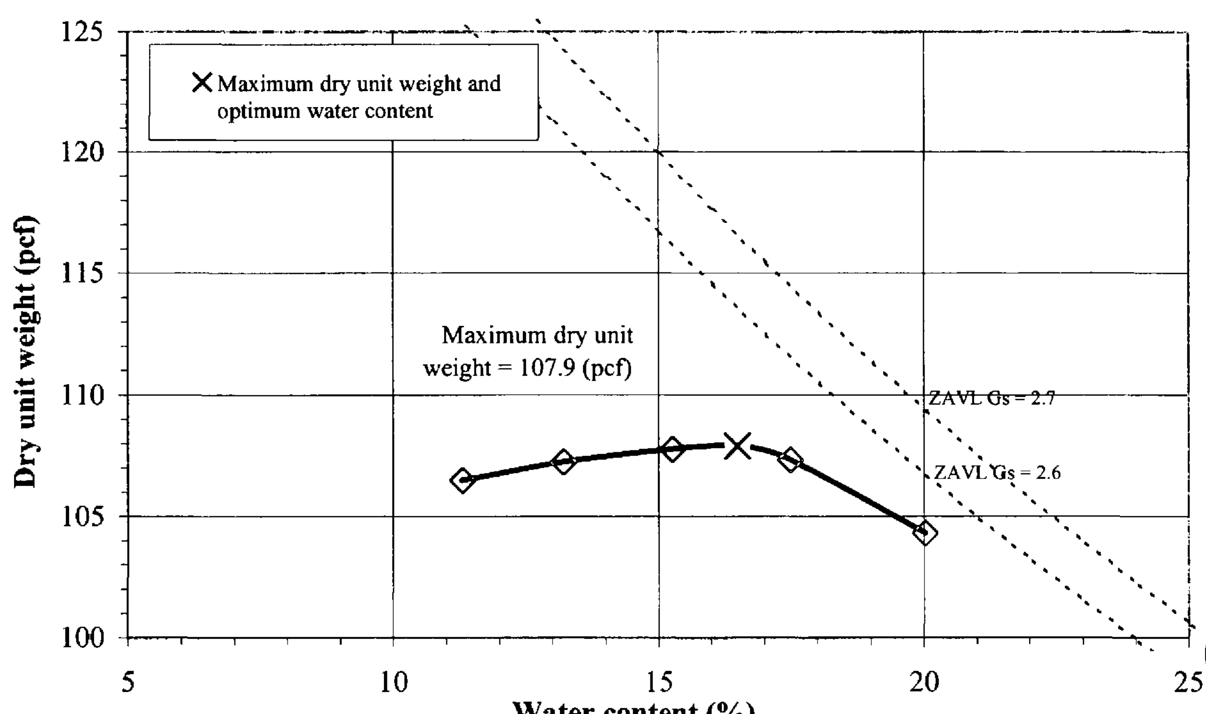
Project: CS Mining - SE Pond
No: 01640-002 (III)
Location: Milford, UT
Date: 8/29/2013
By: ET

Method: ASTM D698 B
Mold Id. Inc 1
Mold volume (ft^3): 0.0333

Boring No.: TP41
Sample:
Depth: 4-6'
Sample Description: Light brown clayey sand
Engineering Classification: Not requested
As-received water content (%): Not requested
Preparation method: Moist
Rammer: Mechanical-circular face
Rock Correction: No

Optimum water content (%): 16.5
Maximum dry unit weight (pcf): 107.9

Point Number	+4%	+6%	+8%	+10%	+12%			
Wt. Sample + Mold (g)	6036.0	6079.7	6122.1	6150.6	6137.0			
Wt. of Mold (g)	4246.4	4246.4	4246.4	4246.4	4246.4			
Wet Unit Wt., γ_m (pcf)	118.5	121.4	124.2	126.1	125.2			
Wet Soil + Tare (g)	603.97	558.67	633.01	738.05	647.39			
Dry Soil + Tare (g)	560.97	512.20	573.18	655.14	574.58			
Tare (g)	180.30	160.40	181.21	181.31	211.00			
Water Content, w (%)	**11.3**	13.2	**15.3**	17.5	20.0			
Dry Unit Wt., γ_d (pcf)	**106.5**	107.2	**107.8**	107.3	104.3			



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Laboratory Compaction Characteristics of Soil

(ASTM D698 / D1557)

IGES

Project: CS Mining - SE Pond
No: 01640-002 (III)
Location: Milford, UT
Date: 8/27/2013
By: ET

Boring No.: TP42
Sample:
Depth: 5-6'
Sample Description: Light brown sand with silt
Engineering Classification: Not requested
As-received water content (%): Not requested

Method: ASTM D698 B
Mold Id. Inc 2
Mold volume (ft^3): 0.0332

Preparation method: Moist
Rammer: Mechanical-circular face
Rock Correction: Yes * See results below
Percent fraction retained, Pc (%) 7.5
Percent fraction passing, Pf (%) 92.5

Optimum water content (%): 14
Maximum dry unit weight (pcf): 117.7

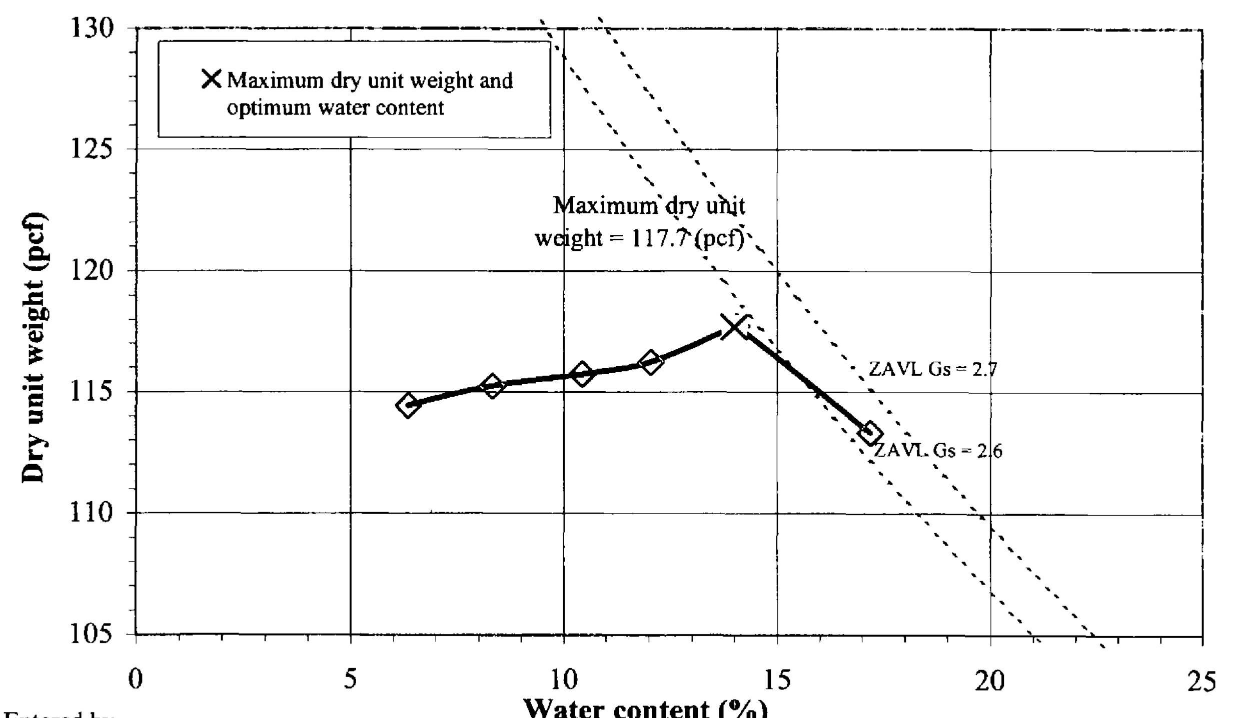
Point Number	+4%	+6%	+8%	+10%	+12%	+16%		
Wt. Sample + Mold (g)	5996.9	6044.1	6089.1	6125.7	6186.7	6164.4		
Wt. of Mold (g)	4161.9	4161.9	4161.9	4161.9	4161.9	4161.9		
Wet Unit Wt., γ_m (pcf)	121.7	124.8	127.8	130.2	134.3	132.8		
Wet Soil + Tare (g)	720.15	664.25	786.40	663.10	847.43	958.94		
Dry Soil + Tare (g)	687.83	629.42	732.12	615.43	769.06	846.90		
Tare (g)	178.57	210.56	211.72	219.87	211.26	195.57		
Water Content, w (%)	**6.3**	8.3	**10.4**	12.1	14.0	**17.2**		
Dry Unit Wt., γ_d (pcf)	**114.4**	115.2	**115.7**	116.2	117.7	**113.3**		

***Correction of Unit Weight and Water Content for Soils Containing Oversize Particles**

(ASTM D4718)

Corrected water content (%): 13.0
Corrected dry unit weight (pcf): 120.3

Oversized fraction, +3/8-in. (%): 7.5
Water content, +3/8-in. (%): 1.0
Sieve for oversized fraction: 3/8-in.
Bulk specific gravity, Gs: 2.65



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Laboratory Compaction Characteristics of Soil

(ASTM D698 / D1557)

IGES

Project: CS Mining - SE Pond
No: 01640-002 (III)
Location: Milford, UT
Date: 8/27/2013
By: JDF

Method: ASTM D698 B
Mold Id. Inc 1
Mold volume (ft^3): 0.0333

Boring No.: TP43
Sample:
Depth: 6-8'
Sample Description: Light brown silty sand with gravel
Engineering Classification: Not requested
As-received water content (%): Not requested
Preparation method: Moist
Rammer: Mechanical-circular face
Rock Correction: Yes * See results below
Percent fraction retained, Pc (%) 14.3
Percent fraction passing, Pf (%) 85.7

Optimum water content (%): 11.5
Maximum dry unit weight (pcf): 120.2

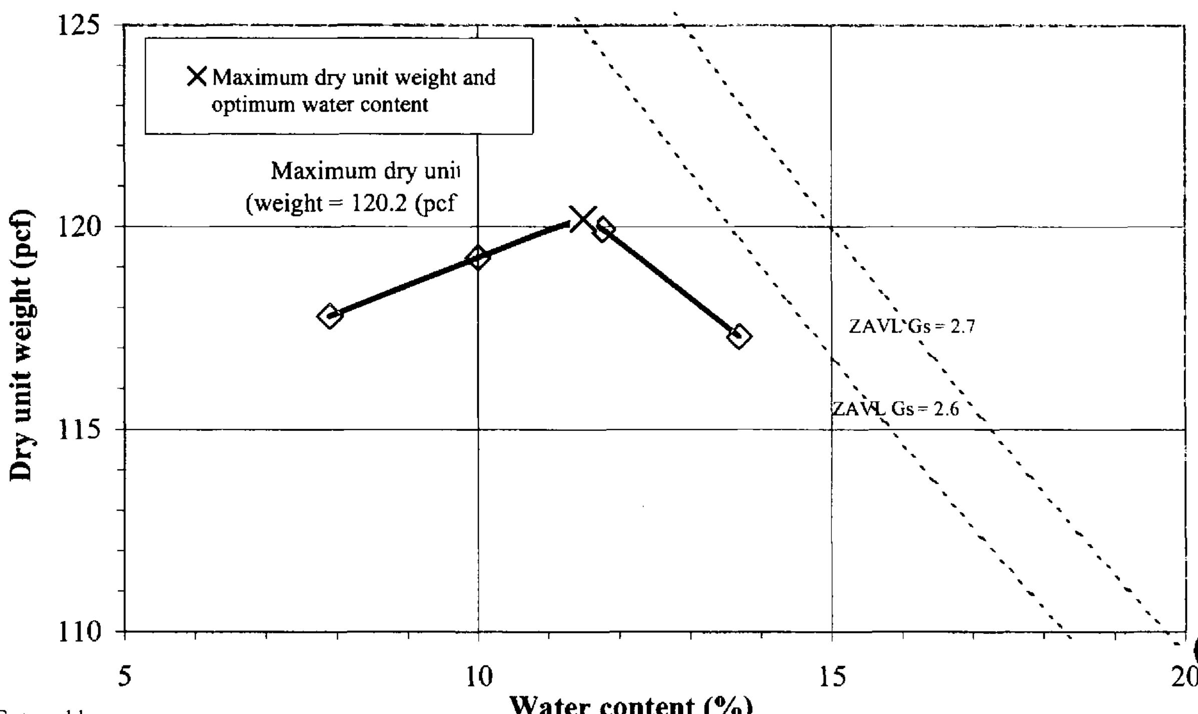
Point Number	+8%	+10%	+6%	+4%				
Wt. Sample + Mold (g)	6270.2	6259.4	6226.3	6165.2				
Wt. of Mold (g)	4246	4246	4246	4246				
Wet Unit Wt., γ_m (pcf)	134.1	133.3	131.1	127.1				
Wet Soil + Tare (g)	669.40	623.70	664.30	687.90				
Dry Soil + Tare (g)	613.65	563.88	615.53	646.49				
Tare (g)	139.90	127.00	127.80	122.40				
Water Content, w (%)	**11.8**	13.7	**10.0**	7.9				
Dry Unit Wt., γ_d (pcf)	**119.9**	117.3	**119.2**	117.8				

*Correction of Unit Weight and Water Content for Soils Containing Oversize Particles

(ASTM D4718)

Corrected water content (%): 10.0
Corrected dry unit weight (pcf): 125.1

Oversized fraction, +3/8-in. (%): 14.3
Water content, +3/8-in. (%): 0.7
Sieve for oversized fraction: 3/8-in.
Bulk specific gravity, Gs: 2.65



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Laboratory Compaction Characteristics of Soil

(ASTM D698 / D1557)

IGES

Project: CS Mining - SE Pond
No: 01640-002 (III)
Location: Milford, UT
Date: 8/30/2013
By: ET

Boring No.: TP44
Sample:
Depth: 5.0'
Sample Description: Light brown sand with clay and gravel
Engineering Classification: Not requested
As-received water content (%): Not requested

Method: ASTM D698 B
Mold Id. Inc 2
Mold volume (ft^3): 0.0332

Preparation method: Moist
Rammer: Mechanical-circular face
Rock Correction: Yes * See results below
Percent fraction retained, Pc (%) 5.1
Percent fraction passing, Pf (%) 94.9

Optimum water content (%): 12.5
Maximum dry unit weight (pcf): 120.9

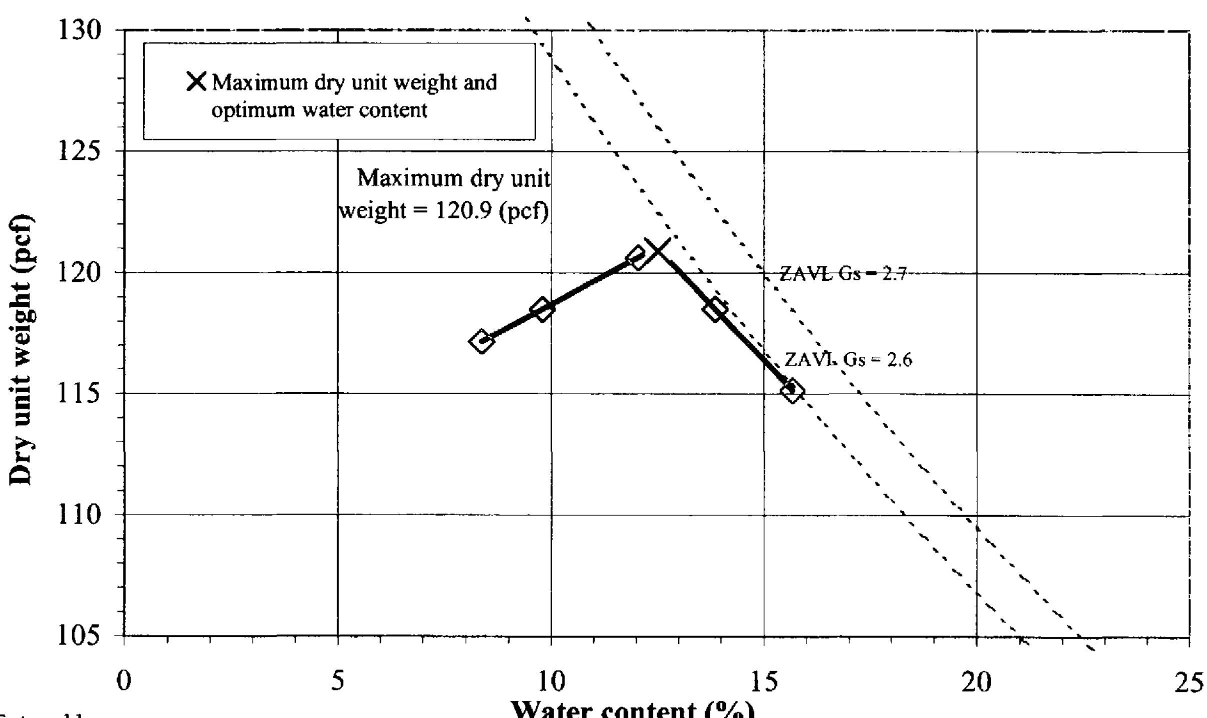
Point Number	+6%	+8%	+10%	+4%	+12%			
Wt. Sample + Mold (g)	6123.4	6199.7	6196.4	6076.1	6170.1			
Wt. of Mold (g)	4161.7	4161.7	4161.7	4161.7	4161.7			
Wet Unit Wt., γ_m (pcf)	130.1	135.2	134.9	127.0	133.2			
Wet Soil + Tare (g)	659.04	683.14	623.29	610.29	690.15			
Dry Soil + Tare (g)	611.71	622.90	563.05	572.95	613.46			
Tare (g)	128.08	122.65	128.40	127.00	124.15			
Water Content, w (%)	**9.8**	**12.0**	**13.9**	**8.4**	**15.7**			
Dry Unit Wt., γ_d (pcf)	**118.5**	**120.6**	**118.5**	**117.2**	**115.1**			

*Correction of Unit Weight and Water Content for Soils Containing Oversize Particles

(ASTM D4718)

Corrected water content (%): 11.9
Corrected dry unit weight (pcf): 122.6

Oversized fraction, +3/8-in. (%): 5.1
Water content, +3/8-in. (%): 0.6
Sieve for oversized fraction: 3/8-in.
Bulk specific gravity, Gs: 2.65 Assumed



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Laboratory Compaction Characteristics of Soil

(ASTM D698 / D1557)

IGES

Project: **CS Mining - SE Pond**
No: **01640-002 (III)**
Location: Milford, UT
Date: 8/29/2013
By: JDF

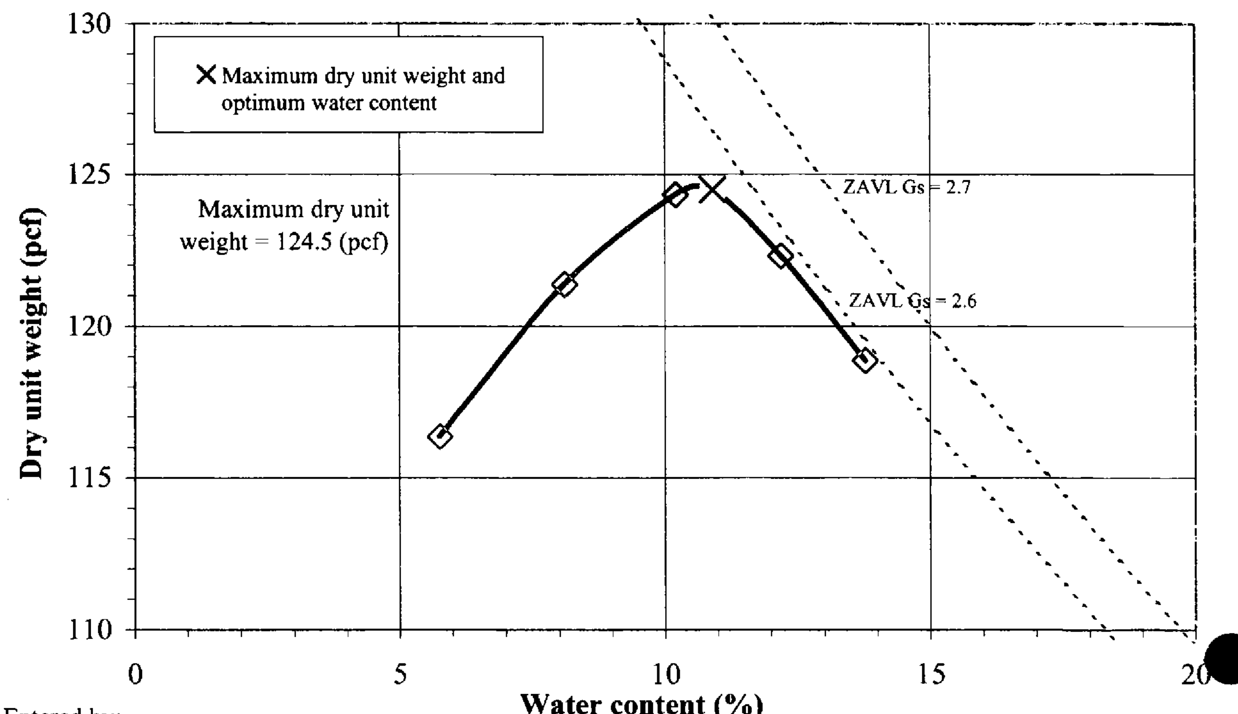
Boring No.: **TP49**
Sample:
Depth: **4-6'**
Sample Description: Brown silty sand
Engineering Classification: Not requested
As-received water content (%): Not requested

Method: ASTM D698 B
Mold Id. Inc 3
Mold volume (ft^3): 0.0332

Preparation method: Moist
Rammer: Mechanical-circular face
Rock Correction: No

Optimum water content (%): **10.9**
Maximum dry unit weight (pcf): **124.5**

Point Number	+6%	+8%	+4%	+2%	As Is			
Wt. Sample + Mold (g)	6238.5	6208.5	6235.3	6147.8	6024.8			
Wt. of Mold (g)	4170.6	4170.6	4170.6	4170.6	4170.6			
Wet Unit Wt., γ_m (pcf)	137.2	135.2	137.0	131.2	123.0			
Wet Soil + Tare (g)	562.26	673.70	639.23	783.55	535.81			
Dry Soil + Tare (g)	514.58	606.90	593.16	734.12	513.39			
Tare (g)	123.41	121.87	141.35	124.09	123.43			
Water Content, w (%)	**12.2**	13.8	**10.2**	8.1	5.7			
Dry Unit Wt., γ_d (pcf)	**122.3**	118.9	**124.3**	121.4	116.4			



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Laboratory Compaction Characteristics of Soil

(ASTM D698 / D1557)

IGES

Project: CS Mining - SE Pond
No: 01640-002 (III)
Location: Milford, UT
Date: 8/28/2013
By: JDF

Method: ASTM D698 B
Mold Id. Inc 1
Mold volume (ft^3): 0.0333

Boring No.: TP51
Sample:
Depth: 4-5'
Sample Description: Brown sand with silt and gravel
Engineering Classification: Not requested
As-received water content (%): Not requested
Preparation method: Moist
Rammer: Mechanical-circular face
Rock Correction: Yes * See results below
Percent fraction retained, Pc (%) 8.4
Percent fraction passing, Pf (%) 91.6

Optimum water content (%): 12.9
Maximum dry unit weight (pcf): 116.6

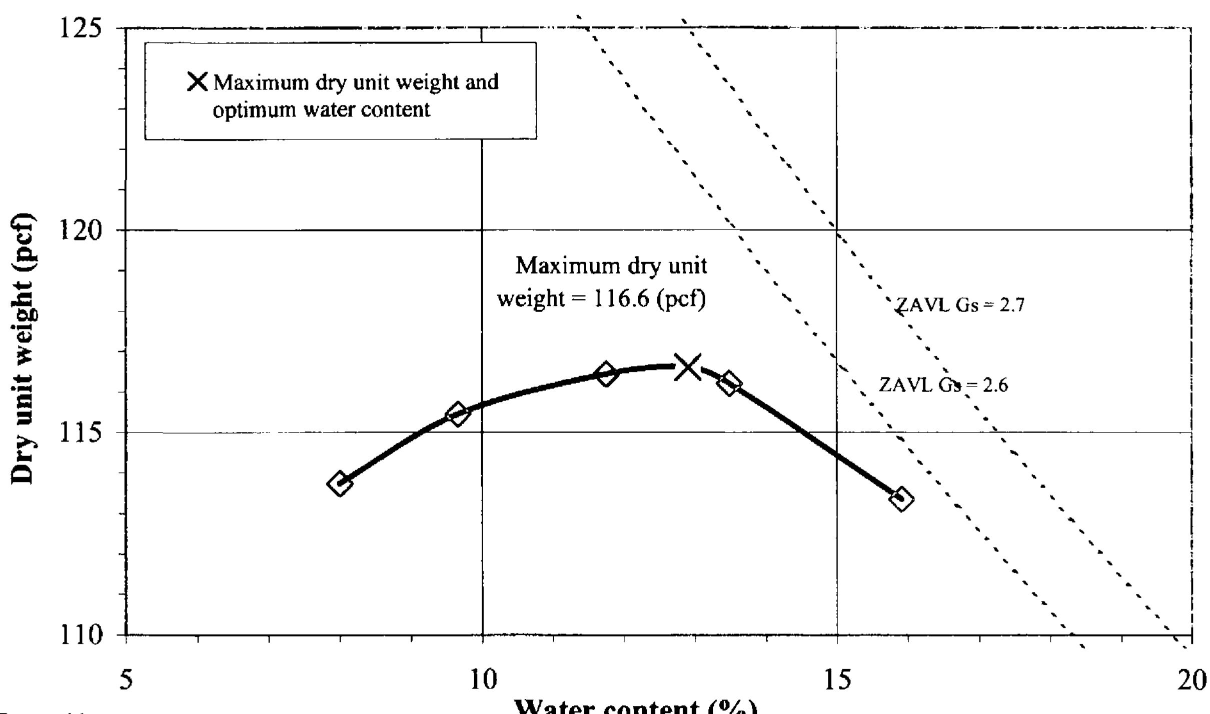
Point Number	+6%	+8%	+10%	+12%	+14%			
Wt. Sample + Mold (g)	6100.8	6157.5	6210.7	6237.3	6230.1			
Wt. of Mold (g)	4246	4246	4246	4246	4246			
Wet Unit Wt., γ_m (pcf)	122.8	126.6	130.1	131.9	131.4			
Wet Soil + Tare (g)	601.04	572.94	505.52	933.47	909.80			
Dry Soil + Tare (g)	565.60	533.77	464.84	843.64	809.48			
Tare (g)	122.36	128.07	118.61	177.34	179.36			
Water Content, w (%)	8.0	9.7	11.7	13.5	15.9			
Dry Unit Wt., γ_d (pcf)	113.7	115.4	116.4	116.2	113.4			

***Correction of Unit Weight and Water Content for Soils Containing Oversize Particles**

(ASTM D4718)

Corrected water content (%): 11.9
Corrected dry unit weight (pcf): 119.6

Oversized fraction, +3/8-in. (%): 8.4
Water content, +3/8-in. (%): 0.6
Sieve for oversized fraction: 3/8-in.
Bulk specific gravity, Gs: 2.65



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Laboratory Compaction Characteristics of Soil

(ASTM D698 / D1557)

Project: CS Mining - SE Pond
No: 01640-002 (III)
Location: Milford, UT
Date: 8/30/2013
By: JDF

Boring No.: TP52
Sample:
Depth: 4-5'
Sample Description: Light brown sand with silt and gravel
Engineering Classification: Not requested
As-received water content (%): Not requested

Method: ASTM D698 B
Mold Id. Inc 1
Mold volume (ft^3): 0.0333

Preparation method: Moist
Rammer: Mechanical-circular face
Rock Correction: Yes * See results below
Percent fraction retained, Pc (%) 12.0
Percent fraction passing, Pf (%) 88.0

Optimum water content (%): 11
Maximum dry unit weight (pcf): 118.9

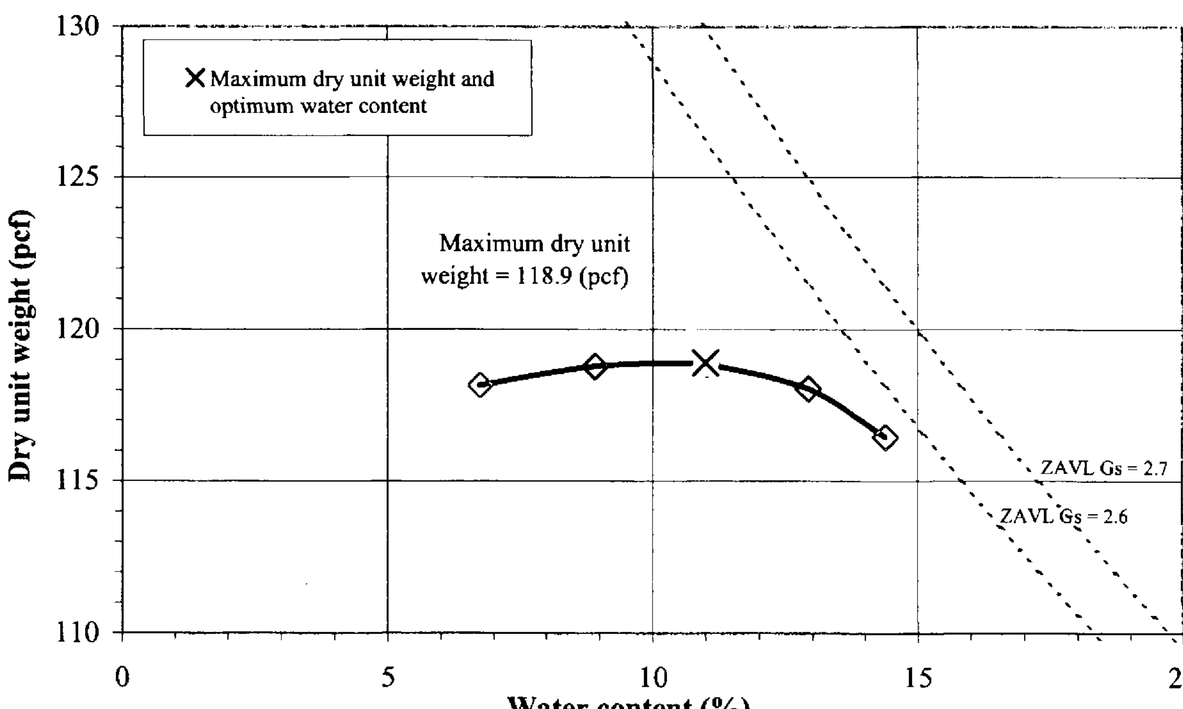
Point Number	+6%	+8%	+10%	+12%	+4%			
Wt. Sample + Mold (g)	6199.1	6238.4	6258.6	6256.9	6150.2			
Wt. of Mold (g)	4245.7	4245.7	4245.7	4245.7	4245.7			
Wet Unit Wt., γ_m (pcf)	129.4	132.0	133.3	133.2	126.1			
Wet Soil + Tare (g)	694.36	675.40	900.69	1119.57	589.29			
Dry Soil + Tare (g)	652.69	629.39	822.08	1005.37	562.18			
Tare (g)	185.03	212.02	213.92	211.90	160.20			
Water Content, w (%)	**8.9**	11.0	**12.9**	14.4	6.7			
Dry Unit Wt., γ_d (pcf)	**118.8**	118.9	**118.0**	116.4	118.2			

*Correction of Unit Weight and Water Content for Soils Containing Oversize Particles

(ASTM D4718)

Corrected water content (%): 9.8
Corrected dry unit weight (pcf): 123.0

Oversized fraction, +3/8-in. (%): 12.0
Water content, +3/8-in. (%): 1.0
Sieve for oversized fraction: 3/8-in.
Bulk specific gravity, Gs: 2.65 Assumed



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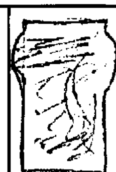
Consolidated Undrained Triaxial Compression Test for Cohesive Soils

(*ASTM D4767*)

IGES

Project: CS Mining - SE Pond
No: 01640-002 (III)
Location: Milford, UT
Date: 9/3/2013
By: MP

Boring No.: TP41
Sample:
Depth: 4-6'
Sample Description: Light brown clayey sand
Engineering Classification: Not requested
Sample type: Laboratory compacted

	Test Number:	S1	S2	S3
Initial	Height, H (in)	5.997	5.998	6.020
	Diameter, D (in)	2.422	2.417	2.416
	Water content, w (%)	16.5	16.5	16.5
	Dry unit weight, γ_d (pcf)	102.1	102.6	102.2
	Saturation (%)	70.7	71.5	70.7
	Void ratio, e	0.62	0.61	0.62
	Mounting	Wet	Wet	Wet
Before shear	Water content, w (%)	23.5	23.0	22.2
	Dry unit weight, γ_d (pcf)	101.9	102.8	104.1
	Saturation[a] (%)	100.0	100.0	100.0
	Void ratio, e	0.62	0.61	0.59
	Area, A_{eoc} (in^2)	4.61	4.57	4.51
	Area method	A	A	A
	B	0.95	0.95	0.95
	t_{50} (min)	0.13	0.12	0.18
	Back pressure (psf)	9791	10512	8351
	Strain rate (%/min)	0.06	0.06	0.06
	Time to failure (min)	320.0	43.3	35.0
	Strain at failure, ε_f (%)	19.20	2.60	2.10
	Filter paper correction	No	No	No
	Membrane correction	Yes	Yes	Yes
	Assumed specific gravity 2.65			

[a] Saturation set to 100% for phase calculations

Summary of strength parameters at peak deviator stress		
Total stress	c (psf)	674
	ϕ (deg)	17.3
Effective stress	c' (psf)	81
	ϕ' (deg)	37.3

Comments:

Test specimens were compacted to 95% of the MDUW at OWC. The maximum dry unit weight and optimum water content obtained from the standard effort compaction test is 107.9 pcf and 16.5% respectively.

Tested by:__________

Reviewed:__________

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Consolidated Undrained Triaxial Compression Test for Cohesive Soils

(*ASTM D4767*)

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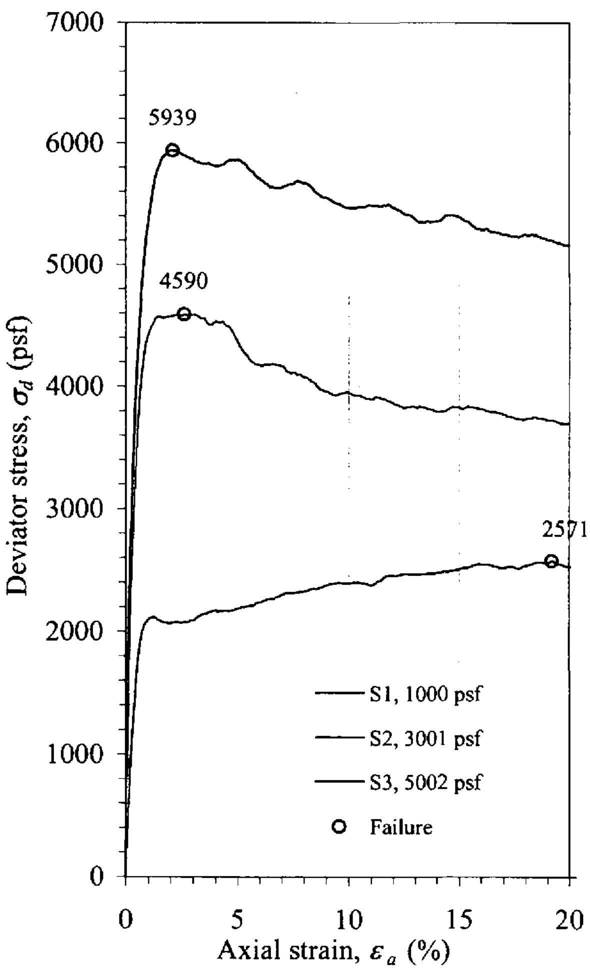
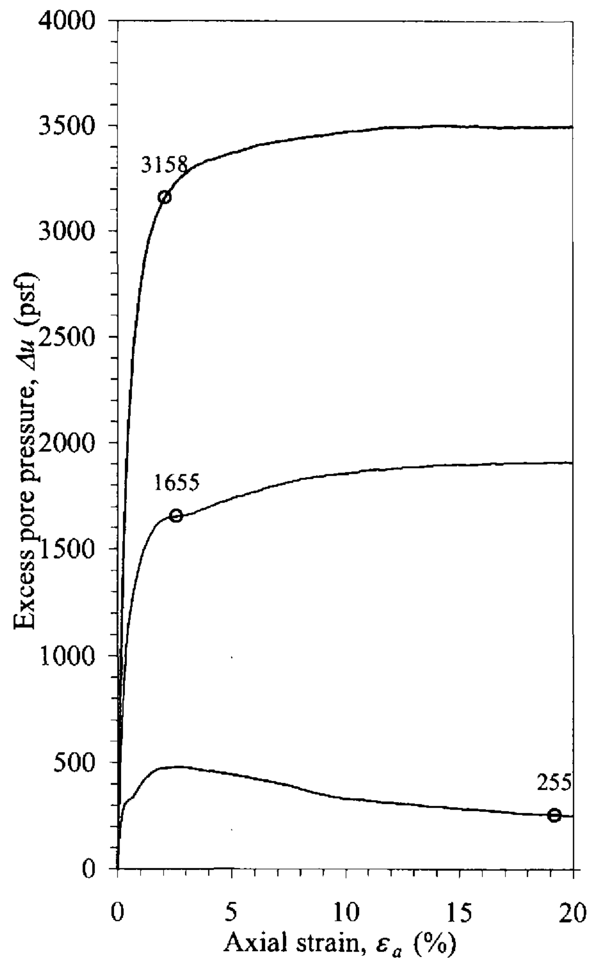
Project: CS Mining - SE Pond
No: 01640-002 (III)
Location: Milford, UT

Boring No.: TP41
Sample:
Depth: 4-6'

	Test Number:	S1	S2	S3
Total stress	σ_3 (psf)	1000	3001	5002
	σ_1-σ_3 (psf)	2571	4590	5939
	σ_1 (psf)	3570	7591	10940
	$q = (\sigma_1-\sigma_3)/2$ (psf)	1285	2295	2969
	$p = (\sigma_1+\sigma_3)/2$ (psf)	2285	5296	7971
Effective stress	Δu (psf)	255	1655	3158
	σ'_3 (psf)	745	1346	1844
	σ'_1-σ'_3 (psf)	2571	4590	5939
	σ'_1 (psf)	3316	5935	7782
	$q = (\sigma'_1-\sigma'_3)/2$ (psf)	1285	2295	2969
	$p' = (\sigma'_1+\sigma'_3)/2$ (psf)	2030	3641	4813
	σ'_1/σ'_3	4.45	4.41	4.22
	$A = \Delta u/(\sigma_1-\sigma_3)$	0.099	0.361	0.532





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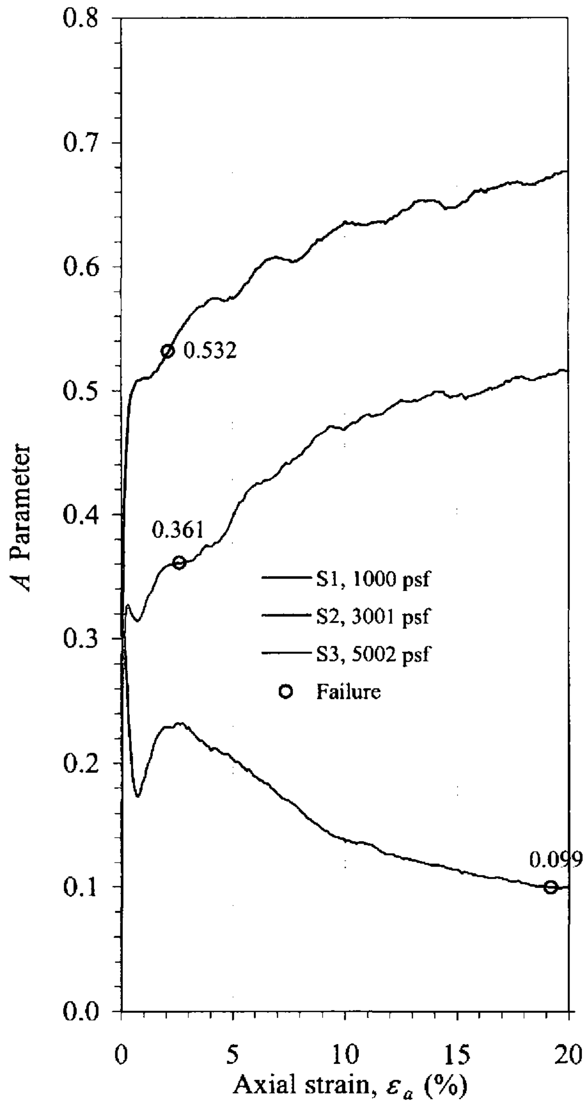
Consolidated Undrained Triaxial Compression Test for Cohesive Soils

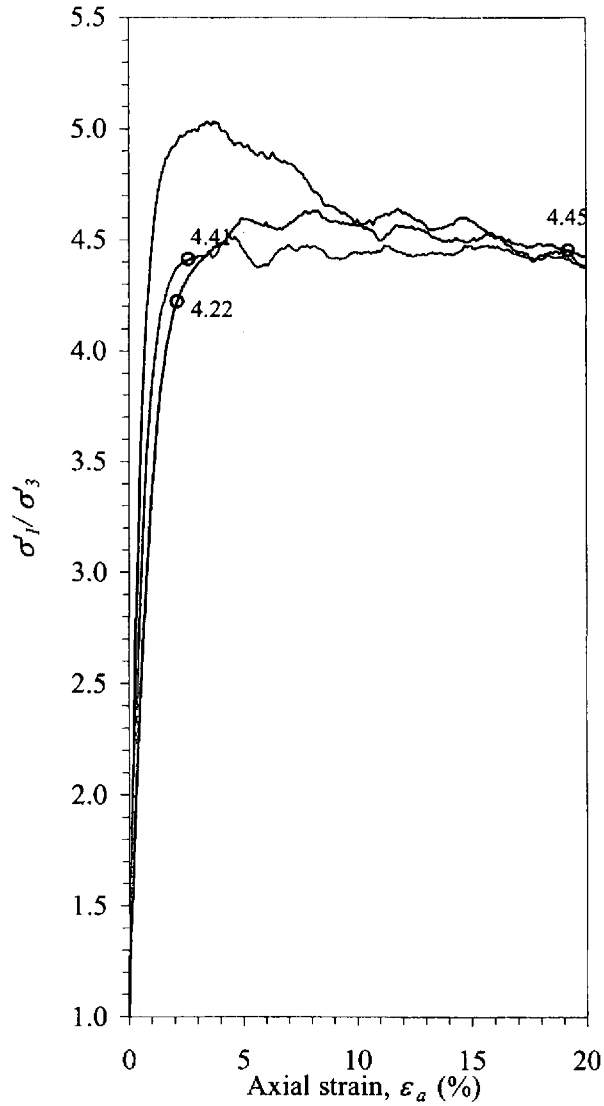
(*ASTM D4767*)

Project: CS Mining - SE Pond
No: 01640-002 (III)
Location: Milford, UT

Boring No.: TP41
Sample:
Depth: 4-6'

Summary of strength parameters at peak deviator stress		
Total stress	c (psf)	674
	ϕ (deg)	17.3
Effective stress	c' (psf)	81
	ϕ' (deg)	37.3





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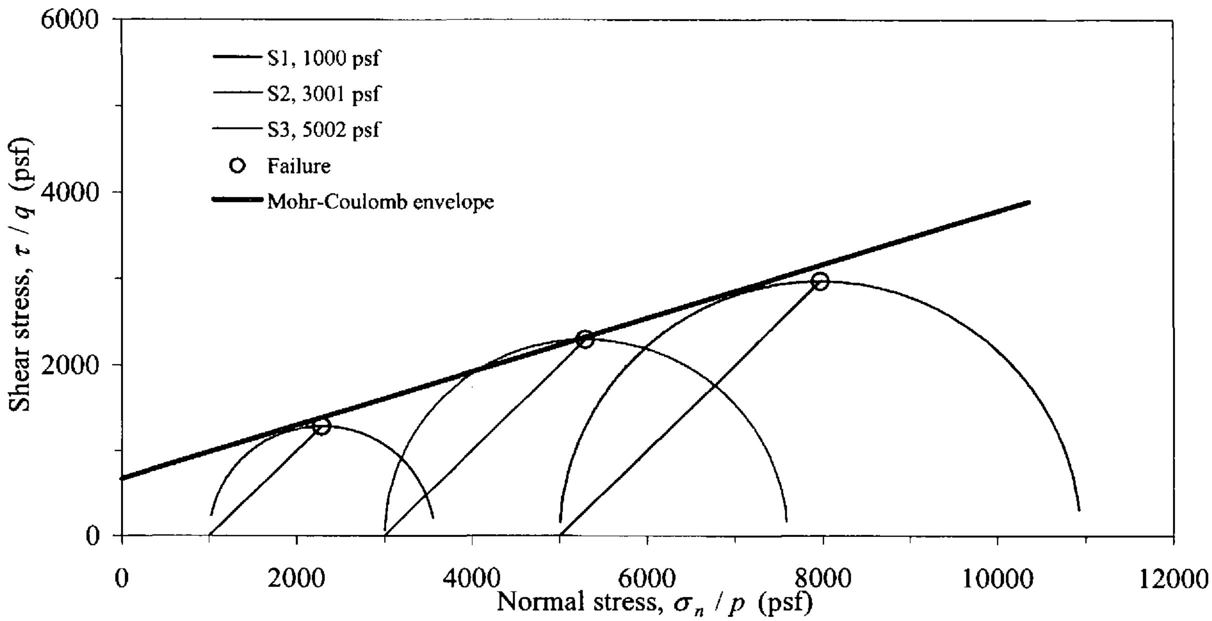
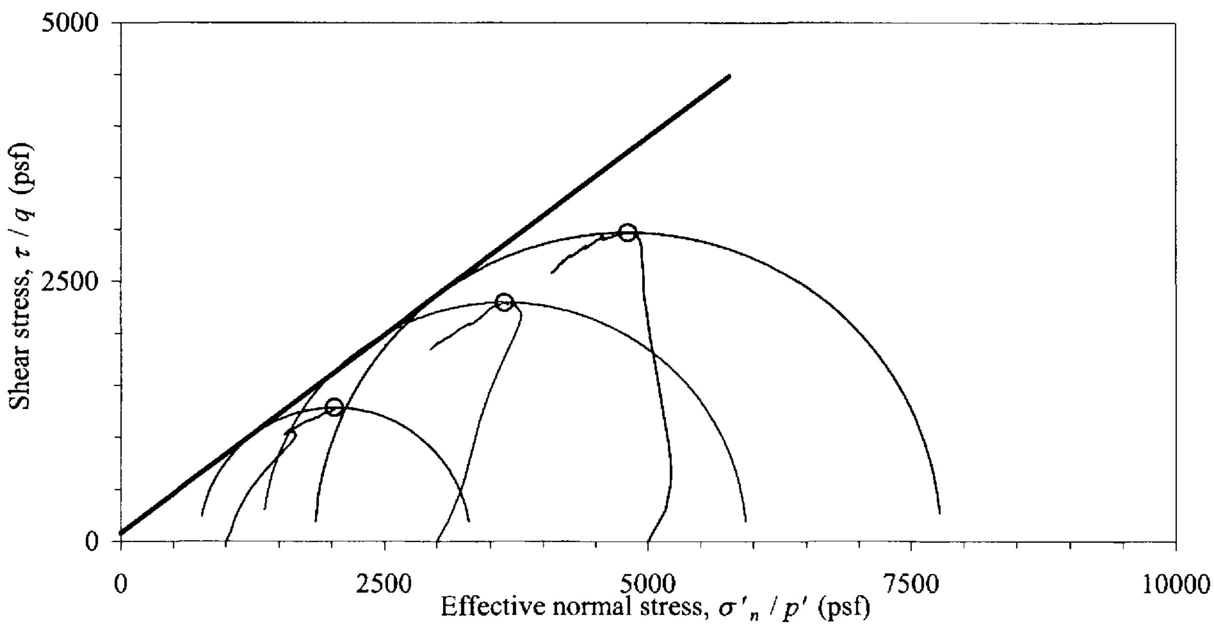
Consolidated Undrained Triaxial Compression Test for Cohesive Soils
(*ASTM D4767*)

Project: CS Mining - SE Pond
No: 01640-002 (III)
Location: Milford, UT

Boring No.: TP41
Sample:
Depth: 4-6'

Summary of strength parameters at peak deviator stress		
Total stress	c (psf)	674
	ϕ (deg)	17.3
Effective stress	c' (psf)	81
	ϕ' (deg)	37.3





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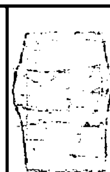
Consolidated Undrained Triaxial Compression Test for Cohesive Soils

(*ASTM D4767*)

IGES

Project: CS Mining - SE Pond
No: 01640-002 (III)
Location: Milford, UT
Date: 9/5/2013
By: MP/NB

Boring No.: TP42
Sample:
Depth: 5-6'
Sample Description: Light brown sand with silt
Engineering Classification: Not requested
Sample type: Laboratory compacted

	Test Number:	S1	S2	S3
Initial	Height, H (in)	5.979	5.967	5.982
	Diameter, D (in)	2.408	2.402	2.415
	Water content, w (%)	14.1	14.1	14.1
	Dry unit weight, γ_d (pcf)	112.4	112.2	112.3
	Saturation (%)	79.3	78.9	79.0
	Void ratio, e	0.47	0.47	0.47
	Mounting	Wet	Wet	Wet
Before shear	Water content, w (%)	16.6	16.9	16.5
	Dry unit weight, γ_d (pcf)	114.8	114.2	115.1
	Saturation[a] (%)	100.0	100.0	100.0
	Void ratio, e	0.44	0.45	0.44
	Area, A_{eoc} (in^2)	4.73	4.77	4.83
	Area method	A	A	A
	B	0.95	0.95	0.95
	t_{50} (min)	0.12	0.14	0.12
	Back pressure (psf)	8352	10511	11952
	Strain rate (%/min)	0.06	0.06	0.06
	Time to failure (min)	260.0	233.3	223.3
	Strain at failure, ε_f (%)	15.60	14.00	13.40
	Filter paper correction	No	No	No
	Membrane correction	Yes	Yes	Yes
Assumed specific gravity	2.65			

[a] Saturation set to 100% for phase calculations

Summary of strength parameters at peak deviator stress		
Total stress	c (psf)	6587
	ϕ (deg)	10.1
Effective stress	c' (psf)	0
	ϕ' (deg)	37.1

Comments:

Test specimens were compacted to 95% of the MDUW at OWC. The maximum dry unit weight and optimum water content obtained from the standard effort compaction test is 117.7 pcf and 14.0% respectively.

Tested by:___________

Reviewed:___________

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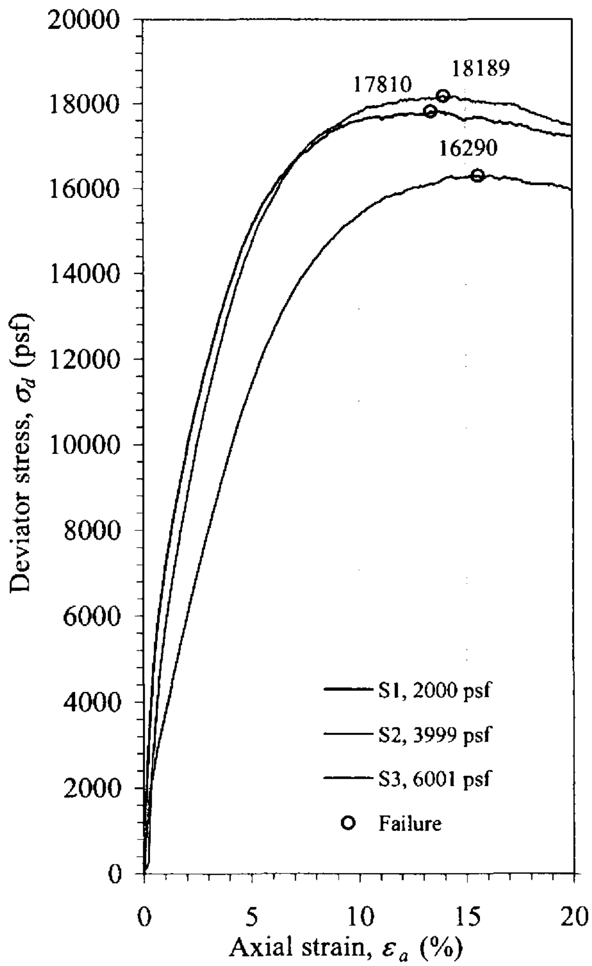
Consolidated Undrained Triaxial Compression Test for Cohesive Soils

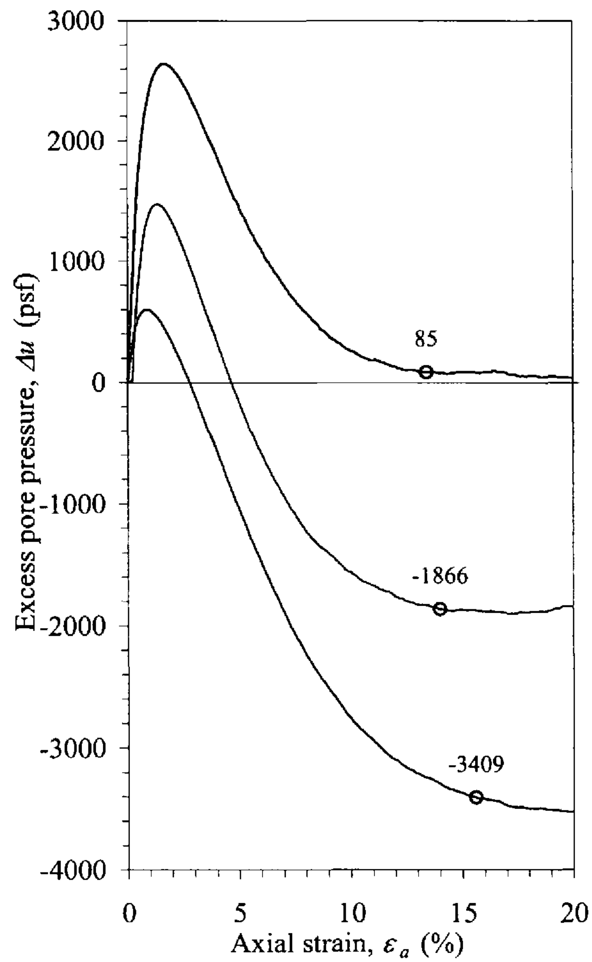
(*ASTM D4767*)

Project: CS Mining - SE Pond
No: 01640-002 (III)
Location: Milford, UT

Boring No.: TP42
Sample:
Depth: 5-6'

	Test Number:	S1	S2	S3
Total stress	σ_3 (psf)	2000	3999	6001
	σ_1-σ_3 (psf)	16290	18189	17810
	σ_1 (psf)	18290	22188	23811
	$q = (\sigma_1 - \sigma_3)/2$ (psf)	8145	9094	8905
	$p = (\sigma_1 + \sigma_3)/2$ (psf)	10145	13094	14906
Effective stress	Δu (psf)	-3409	-1866	85
	σ'_3 (psf)	5409	5866	5916
	σ'_1-σ'_3 (psf)	16290	18189	17810
	σ'_1 (psf)	21699	24054	23726
	$q = (\sigma'_1 - \sigma'_3)/2$ (psf)	8145	9094	8905
	$p' = (\sigma'_1 + \sigma'_3)/2$ (psf)	13554	14960	14821
	σ'_1/σ'_3	4.01	4.10	4.01
	$A = \Delta u/(\sigma_1 - \sigma_3)$	-0.209	-0.103	0.005





Z:\PROJECTS\01640_CS_mining\002_SW_Facility\III\[GTXCU3v2_TP42_5-6.xls]Summary

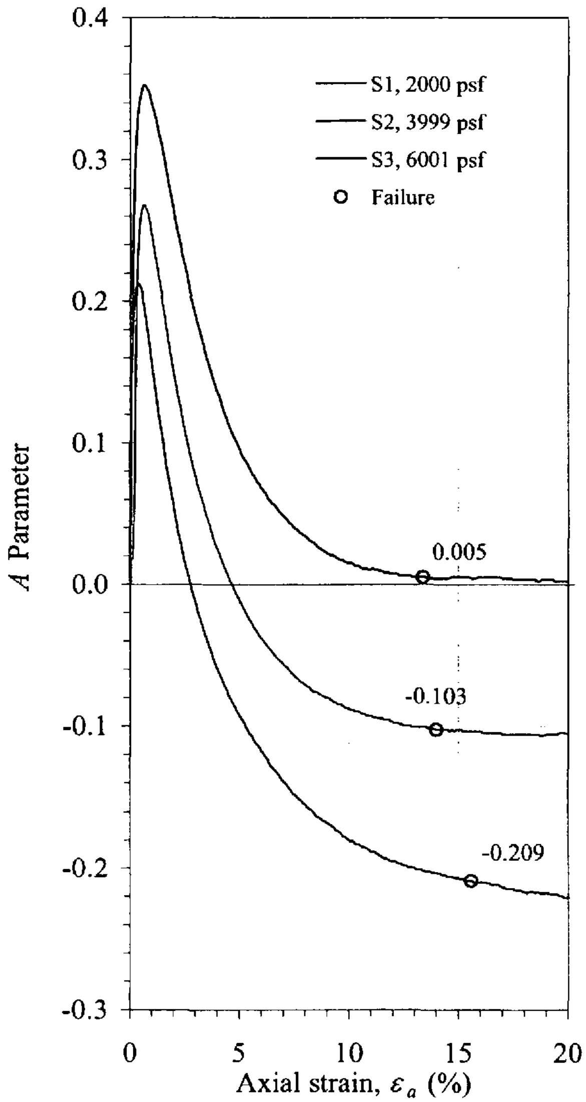
Consolidated Undrained Triaxial Compression Test for Cohesive Soils

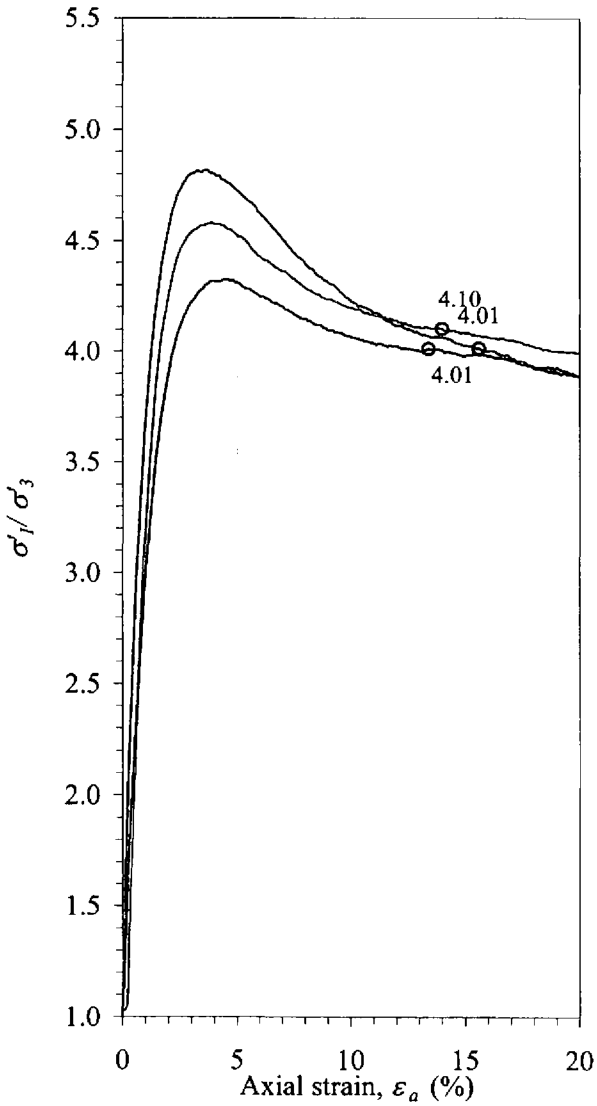
(*ASTM D4767*)

Project: CS Mining - SE Pond
No: 01640-002 (III)
Location: Milford, UT

Boring No.: TP42
Sample:
Depth: 5-6'

Summary of strength parameters at peak deviator stress		
Total stress	c (psf)	6587
	ϕ (deg)	10.1
Effective stress	c' (psf)	0
	ϕ' (deg)	37.1





Z:\PROJECTS\01640_CS_mining\002_SW_Facility\III\[GTXCU3v2_TP42_5-6.xls]Summary

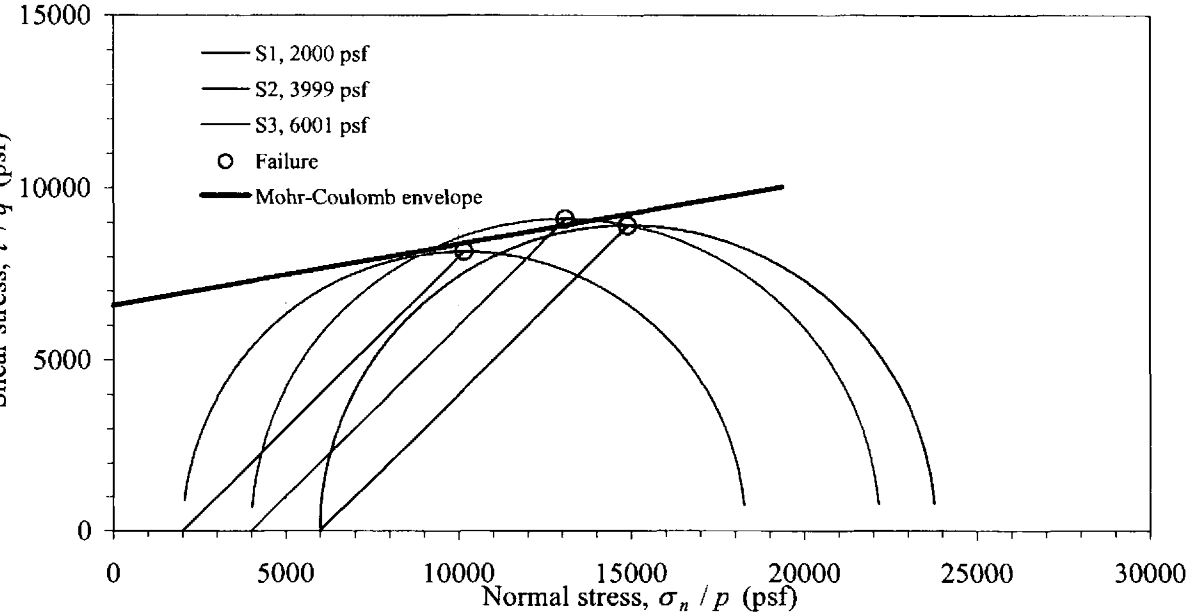
Consolidated Undrained Triaxial Compression Test for Cohesive Soils

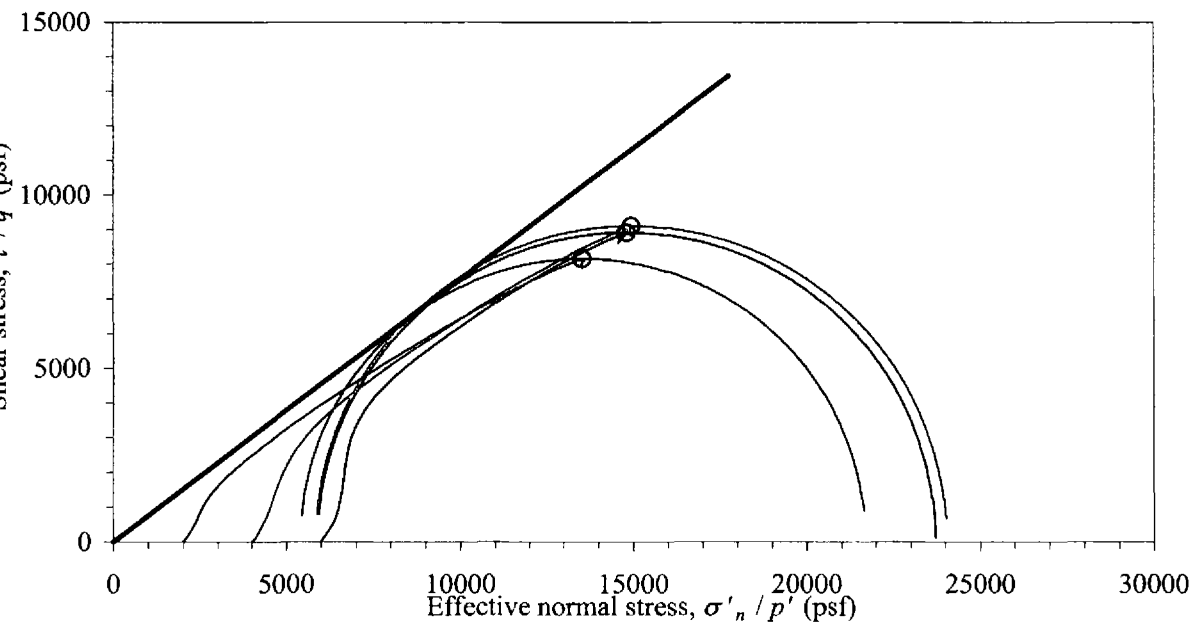
(*ASTM D4767*)

Project: CS Mining - SE Pond
No: 01640-002 (III)
Location: Milford, UT

Boring No.: TP42
Sample:
Depth: 5-6'

Summary of strength parameters at peak deviator stress		
Total stress	c (psf)	6587
	ϕ (deg)	10.1
Effective stress	c' (psf)	0
	ϕ' (deg)	37.1





Z:\PROJECTS\01640_CS_mining\002_SW_Facility\III\[GTXCU3v2_TP42_5-6.xls]Summary

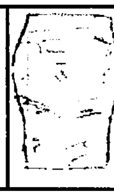
<u>Consolidated Undrained Triaxial Compression Test for Cohesive Soils</u>

(*ASTM D4767*)

IGES

Project: **CS Mining - SE Pond**
No: **01640-002 (III)**
Location: Milford, UT
Date: 9/10/2013
By: MP

Boring No.: **TP43**
Sample:
Depth: **6-8'**
Sample Description: Brown silty sand with gravel
Engineering Classification: Not requested
Sample type: Laboratory compacted

	Test Number:	S1	S2	S3
Initial	Height, H (in)	5.973	5.993	5.979
	Diameter, D (in)	2.419	2.418	2.422
	Water content, w (%)	11.1	11.1	11.1
	Dry unit weight, γ_d (pcf)	114.6	114.1	114.1
	Saturation (%)	66.4	65.5	65.5
	Void ratio, e	0.44	0.45	0.45
	Mounting	Wet	Wet	Wet
Before shear	Water content, w (%)	16.7	16.4	16.3
	Dry unit weight, γ_d (pcf)	114.7	115.4	115.5
	Saturation[a] (%)	100.0	100.0	100.0
	Void ratio, e	0.44	0.43	0.43
	Area, A_{eoc} (in^2)	4.59	4.55	4.56
	Area method	A	A	A
	B	0.95	0.95	0.95
	t_{50} (min)	0.09	0.11	0.12
	Back pressure (psf)	8350	11951	9791
	Strain rate (%/min)	0.06	0.06	0.06
	Time to failure (min)	28.3	25.0	55.0
	Strain at failure, ε_f (%)	1.70	1.50	3.30
	Filter paper correction	No	No	No
	Membrane correction	Yes	Yes	Yes
	Assumed specific gravity 2.65			

[a] Saturation set to 100% for phase calculations

Summary of strength parameters at peak deviator stress		
Total stress	c (psf)	999
	ϕ (deg)	17.2
Effective stress	c' (psf)	130
	ϕ' (deg)	36.7

Comments:

Test specimens were compacted to 95% of the MDUW at OWC. The maximum dry unit weight and optimum water content obtained from standard effort compaction test is 120.2 pcf and 11.5% respectively.

Tested by:__________

Reviewed:__________

Z:\PROJECTS\01640_CS_mining\002_SW_Facility\III\[GTXCU3v2_TP43_6-8.xls]Summary

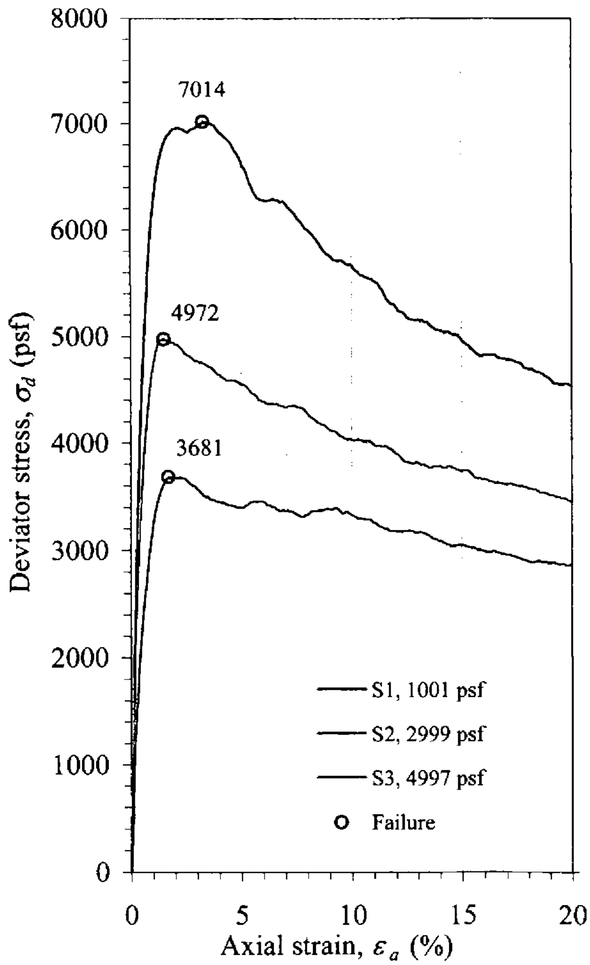
<u>Consolidated Undrained Triaxial Compression Test for Cohesive Soils</u>

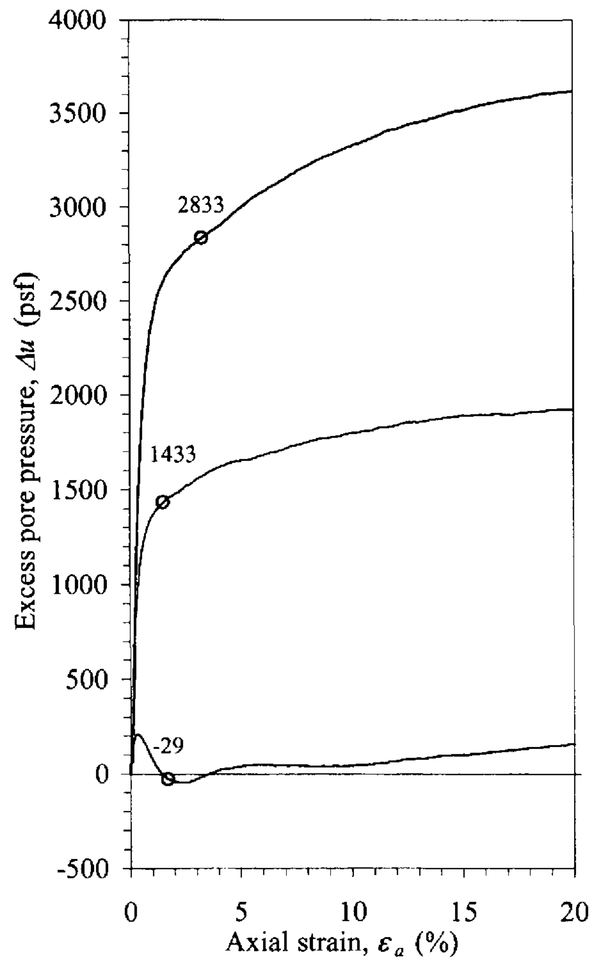
(*ASTM D4767*)

Project: CS Mining - SE Pond
No: 01640-002 (III)
Location: Milford, UT

Boring No.: TP43
Sample:
Depth: 6-8'

	Test Number:	S1	S2	S3
Total stress	σ_3 (psf)	1001	2999	4997
	$\sigma_1 - \sigma_3$ (psf)	3681	4972	7014
	σ_1 (psf)	4683	7972	12011
	$q = (\sigma_1 - \sigma_3)/2$ (psf)	1841	2486	3507
	$p = (\sigma_1 + \sigma_3)/2$ (psf)	2842	5486	8504
Effective stress	Δu (psf)	-29	1433	2833
	σ'_3 (psf)	1031	1566	2164
	$\sigma'_1 - \sigma'_3$ (psf)	3681	4972	7014
	σ'_1 (psf)	4712	6539	9178
	$q = (\sigma'_1 - \sigma'_3)/2$ (psf)	1841	2486	3507
	$p' = (\sigma'_1 + \sigma'_3)/2$ (psf)	2871	4052	5671
	σ'_1/σ'_3	4.57	4.18	4.24
	$A = \Delta u/(\sigma_1 - \sigma_3)$	-0.008	0.288	0.404





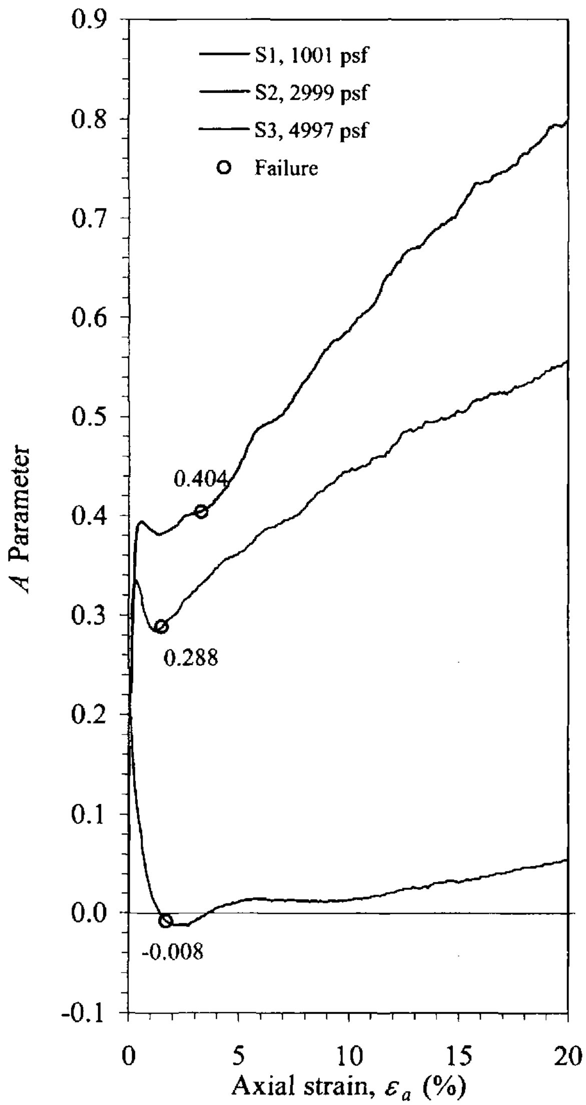
Consolidated Undrained Triaxial Compression Test for Cohesive Soils

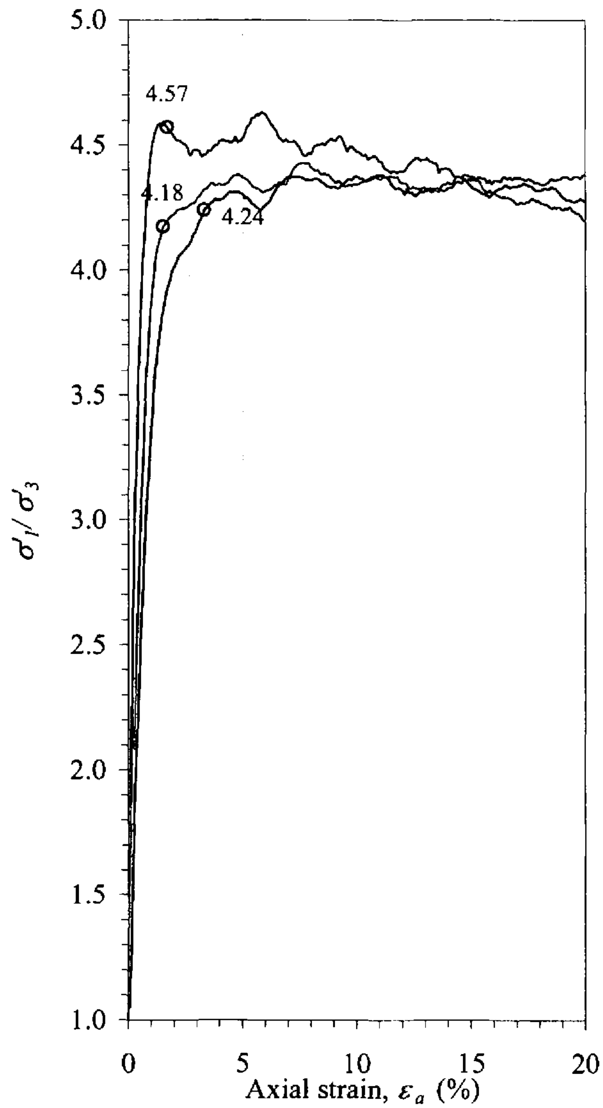
(*ASTM D4767*)

Project: CS Mining - SE Pond
No: 01640-002 (III)
Location: Milford, UT

Boring No.: TP43
Sample:
Depth: 6-8'

Summary of strength parameters at peak deviator stress		
Total stress	c (psf)	999
	ϕ (deg)	17.2
Effective stress	c' (psf)	130
	ϕ' (deg)	36.7





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Consolidated Undrained Triaxial Compression Test for Cohesive Soils

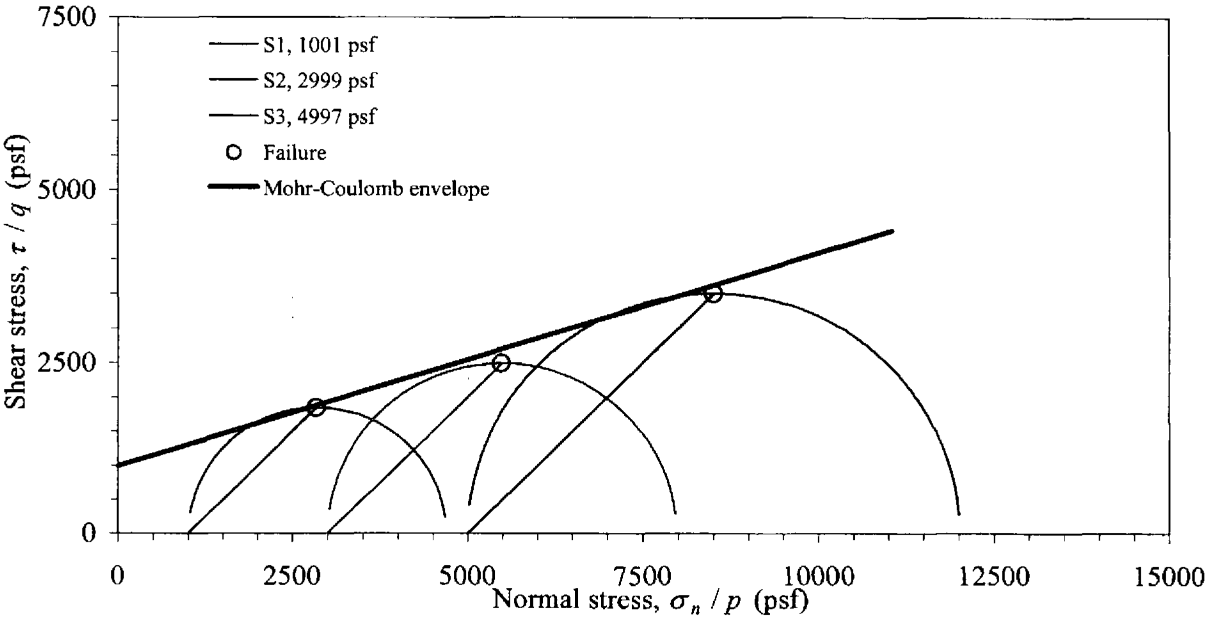
(*ASTM D4767*)

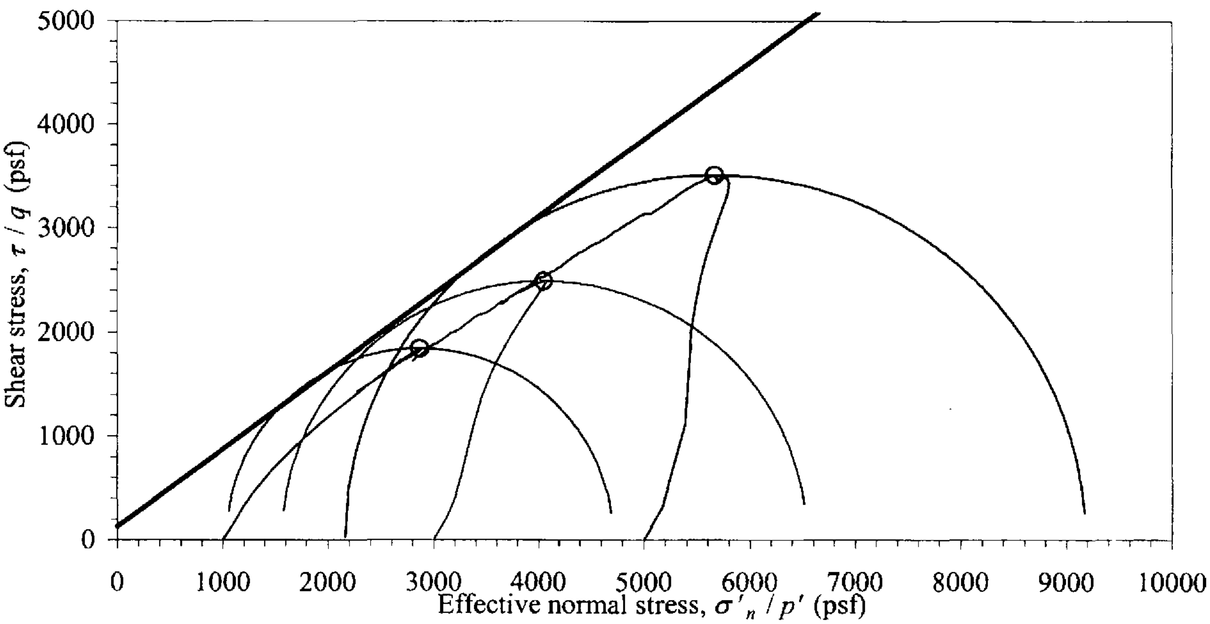
IGES

Project: CS Mining - SE Pond
No: 01640-002 (III)
Location: Milford, UT

Boring No.: TP43
Sample:
Depth: 6-8'

Summary of strength parameters at peak deviator stress		
Total stress	c (psf)	999
	ϕ (deg)	17.2
Effective stress	c' (psf)	130
	ϕ' (deg)	36.7





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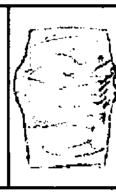
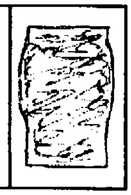
Consolidated Undrained Triaxial Compression Test for Cohesive Soils

(*ASTM D4767*)

IGES

Project: **CS Mining - SE Pond**
No: **01640-002 (III)**
Location: Milford, UT
Date: 9/18/2013
By: MP

Boring No.: **TP44**
Sample:
Depth: **5.0'**
Sample Description: Light brown sand with clay and gravel
Engineering Classification: Not requested
Sample type: Laboratory compacted

	Test Number:	S1	S2	S3
Initial	Height, H (in)	5.995	6.001	6.019
	Diameter, D (in)	2.413	2.413	2.410
	Water content, w (%)	12.1	12.1	12.1
	Dry unit weight, γ_d (pcf)	115.3	115.2	115.2
	Saturation (%)	74.0	73.7	73.6
	Void ratio, e	0.43	0.44	0.44
	Mounting	Wet	Wet	Wet
Before shear	Water content, w (%)	15.4	14.9	14.9
	Dry unit weight, γ_d (pcf)	117.5	118.7	118.6
	Saturation[a] (%)	100.0	100.0	100.0
	Void ratio, e	0.41	0.39	0.39
	Area, A_{eoc} (in^2)	4.49	4.44	4.43
	Area method	A	A	A
	B	0.95	0.95	0.95
	t_{50} (min)	0.12	0.15	0.20
	Back pressure (psf)	9790	9790	8353
	Strain rate (%/min)	0.06	0.06	0.06
	Time to failure (min)	270.0	333.3	298.3
	Strain at failure, ε_f (%)	16.20	20.00	17.90
	Filter paper correction	No	No	No
	Membrane correction	Yes	Yes	Yes
Assumed specific gravity	2.65			

[a] Saturation set to 100% for phase calculations

Summary of strength parameters at peak deviator stress		
Total stress	c (psf)	2271
	ϕ (deg)	20.2
Effective stress	c' (psf)	6
	ϕ' (deg)	39.1

Comments:

Test specimens were compacted to a 95% of the MDUW at OWC. The maxium dry unit weight and optimum water content obtained from the standard effort compaction test is 120.9 pcf and 12.5% respectively.

Tested by:___________

Reviewed:___________

Z:\PROJECTS\01640_CS_mining\002_SW_Facility\III\[GTXCU3v2_TP44_5.xls]Summary

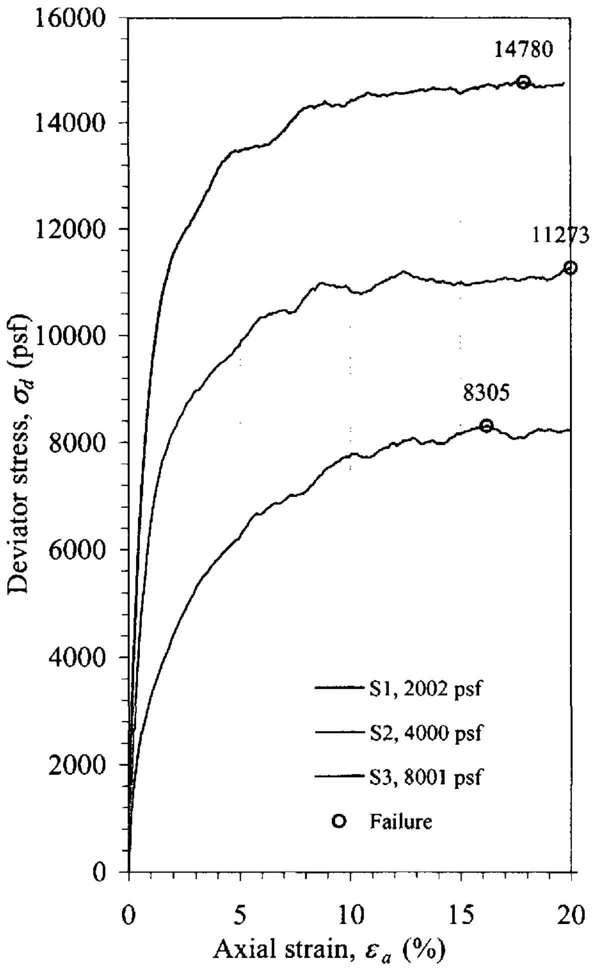
Consolidated Undrained Triaxial Compression Test for Cohesive Soils

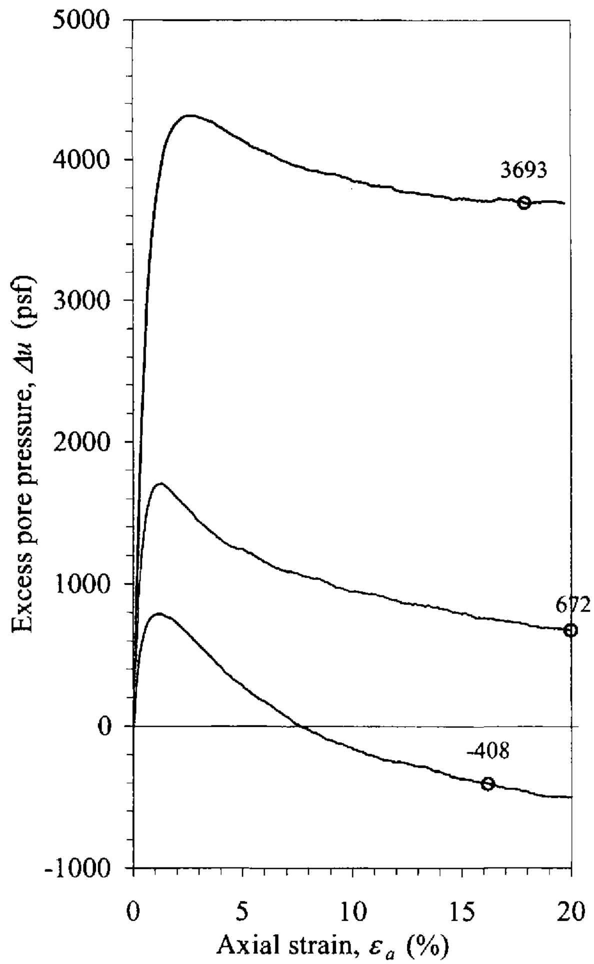
(*ASTM D4767*)

Project: CS Mining - SE Pond
No: 01640-002 (III)
Location: Milford, UT

Boring No.: TP44
Sample:
Depth: 5.0'

	Test Number:	S1	S2	S3
Total stress	σ_3 (psf)	2002	4000	8001
	σ_1-σ_3 (psf)	8305	11273	14780
	σ_1 (psf)	10307	15272	22781
	$q = (\sigma_1 - \sigma_3)/2$ (psf)	4153	5636	7390
	$p = (\sigma_1 + \sigma_3)/2$ (psf)	6154	9636	15391
Effective stress	Δu (psf)	-408	672	3693
	σ'_3 (psf)	2409	3328	4308
	σ'_1-σ'_3 (psf)	8305	11273	14780
	σ'_1 (psf)	10715	14600	19088
	$q = (\sigma'_1 - \sigma'_3)/2$ (psf)	4153	5636	7390
	$p' = (\sigma'_1 + \sigma'_3)/2$ (psf)	6562	8964	11698
	σ'_1/σ'_3	4.45	4.39	4.43
	$A = \Delta u/(\sigma_1 - \sigma_3)$	-0.049	0.060	0.250





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<u>**Consolidated Undrained Triaxial Compression Test for Cohesive Soils**</u>

(*ASTM D4767*)

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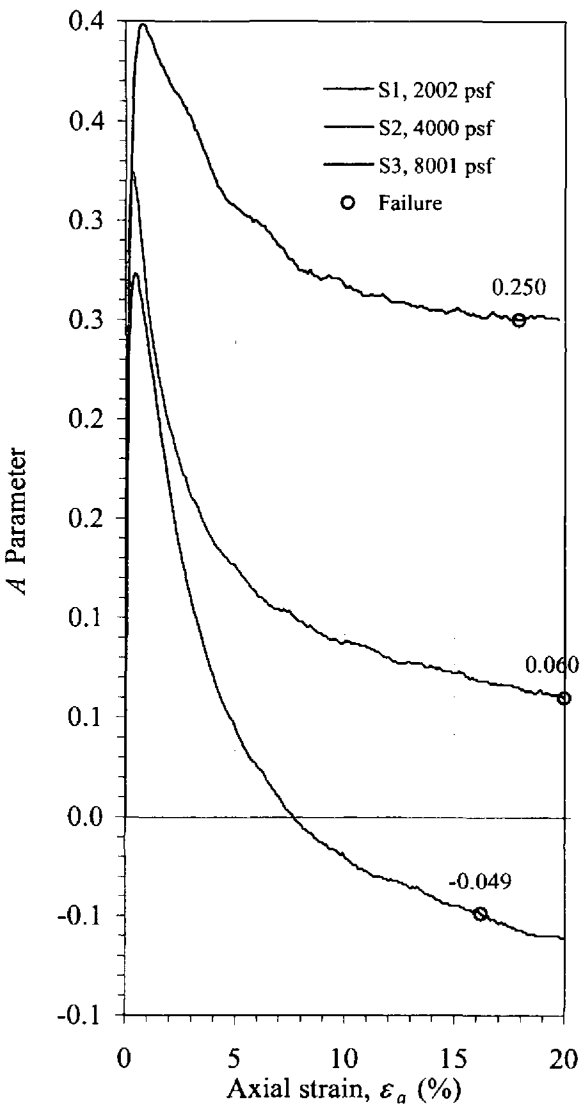
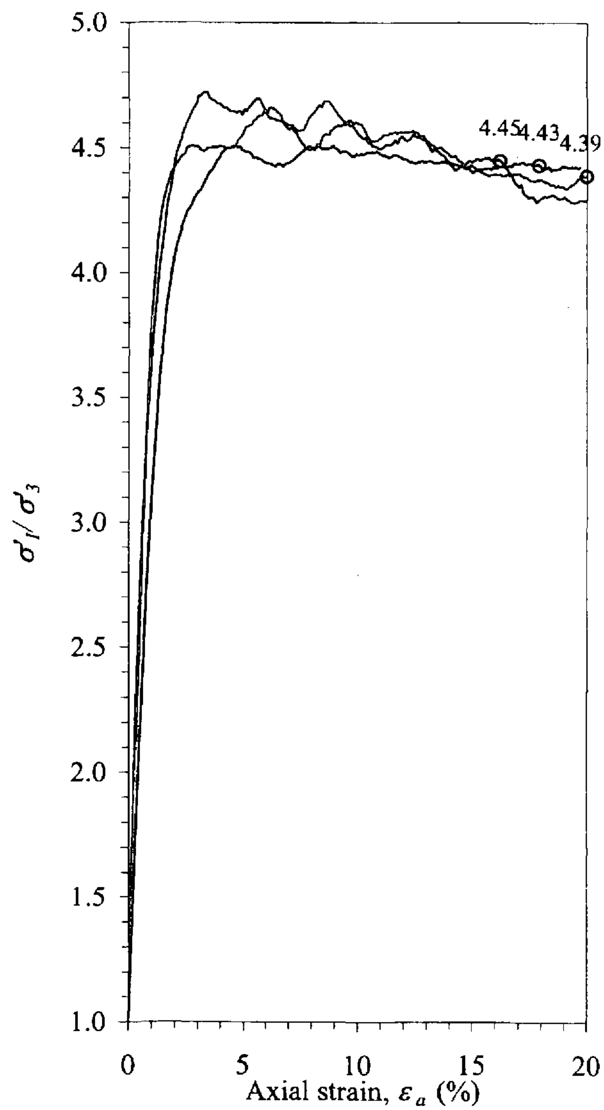
Project: CS Mining - SE Pond
No: 01640-002 (III)
Location: Milford, UT

Boring No.: TP44
Sample:
Depth: 5.0'

Summary of strength parameters at peak deviator stress		
Total stress	c (psf)	2271
	ϕ (deg)	20.2
Effective stress	c' (psf)	6
	ϕ' (deg)	39.1





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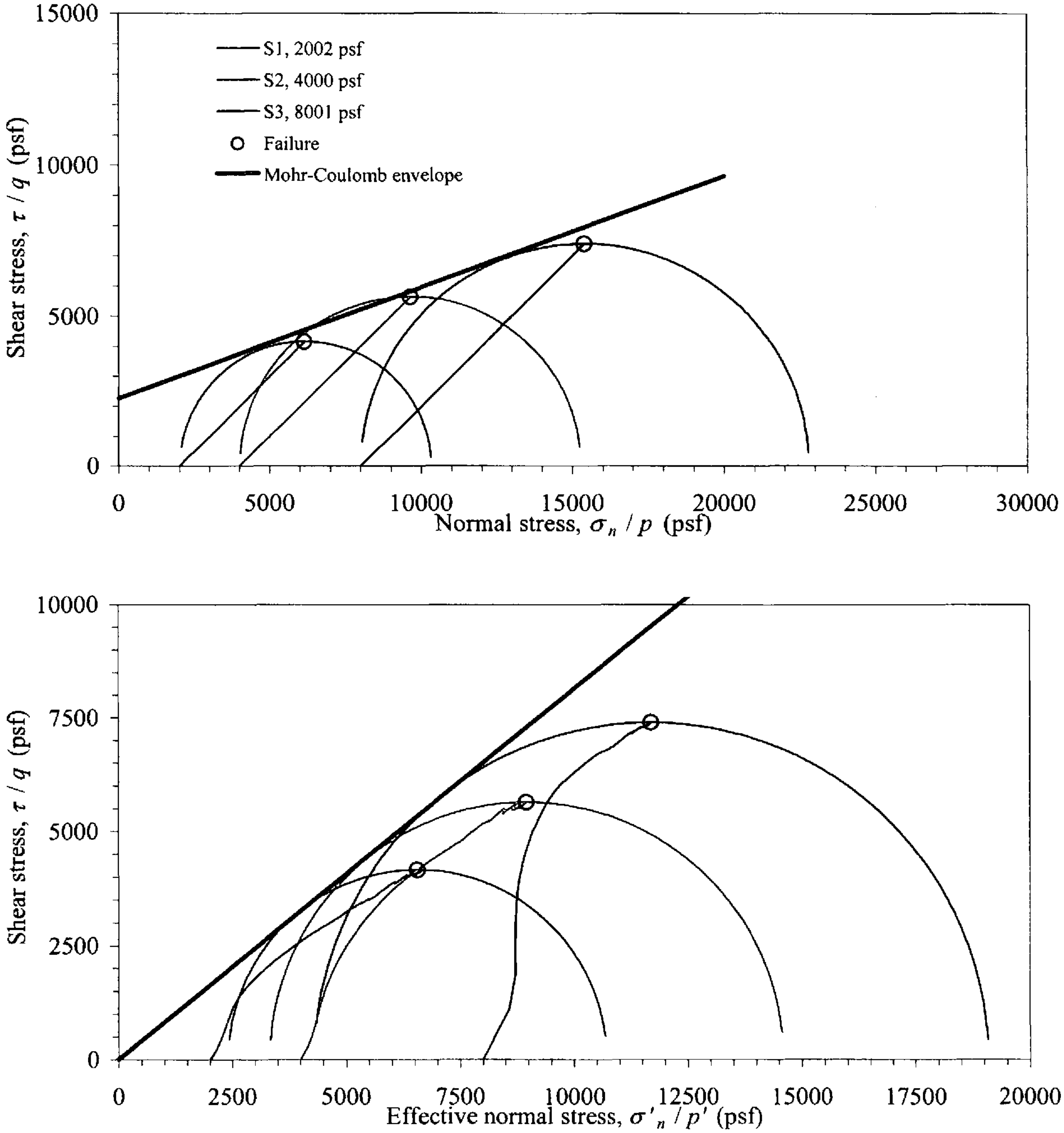
Consolidated Undrained Triaxial Compression Test for Cohesive Soils
(*ASTM D4767*)

Project: CS Mining - SE Pond
No: 01640-002 (III)
Location: Milford, UT

Boring No.: TP44
Sample:
Depth: 5.0'

Summary of strength parameters at peak deviator stress		
Total stress	c (psf)	2271
	ϕ (deg)	20.2
Effective stress	c' (psf)	6
	ϕ' (deg)	39.1



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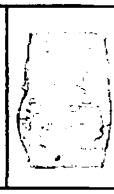
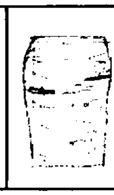
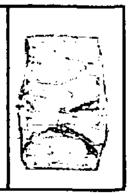
Consolidated Undrained Triaxial Compression Test for Cohesive Soils

(ASTM D4767)

Project: CS Mining - SE Pond
No: 01640-002 (III)
Location: Milford, UT
Date: 9/23/2013
By: MP

Boring No.: TP51
Sample:
Depth: 4-5'
Sample Description: Brown sand with silt and gravel
Engineering Classification: Not requested
Sample type: Laboratory compacted

	Test Number:	S1	S2	S3
Initial	Height, H (in)	6.010	6.010	6.015
	Diameter, D (in)	2.410	2.410	2.414
	Water content, w (%)	12.4	12.4	12.4
	Dry unit weight, γ_d (pcf)	111.2	111.2	110.8
	Saturation (%)	67.6	67.6	66.7
	Void ratio, e	0.49	0.49	0.49
	Mounting	Wet	Wet	Wet
Before shear	Water content, w (%)	17.6	17.2	16.5
	Dry unit weight, γ_d (pcf)	112.8	113.7	115.0
	Saturation[a] (%)	100.0	100.0	100.0
	Void ratio, e	0.47	0.45	0.44
	Area, A_{eoc} (in^2)	5.05	4.46	4.40
	Area method	A	A	A
	B	0.95	0.95	0.95
	t_{50} (min)	0.12	0.11	0.17
	Back pressure (psf)	9791	9791	9791
	Strain rate (%/min)	0.06	0.06	0.06
	Time to failure (min)	228.3	141.7	126.7
	Strain at failure, ε_f (%)	13.70	8.50	7.60
	Filter paper correction	No	No	No
	Membrane correction	Yes	Yes	Yes
Assumed specific gravity	2.65			

[a] Saturation set to 100% for phase calculations

Summary of strength parameters at peak deviator stress		
Total stress	c (psf)	2577
	ϕ (deg)	23.4
Effective stress	c' (psf)	0
	ϕ' (deg)	38.9

Comments:
Test specimens were compacted to 95% of the MDUW at OWC. The maximum dry unit weight and optimum water content obtained from the standard effort compaction test is 116.6 pcf and 12.9% respectively.

Tested by:__________
Reviewed:__________

Z:\PROJECTS\01640_CS_mining\002_SW_Facility\III\[GTXCU3v2_TP51_4-5.xls]Summary

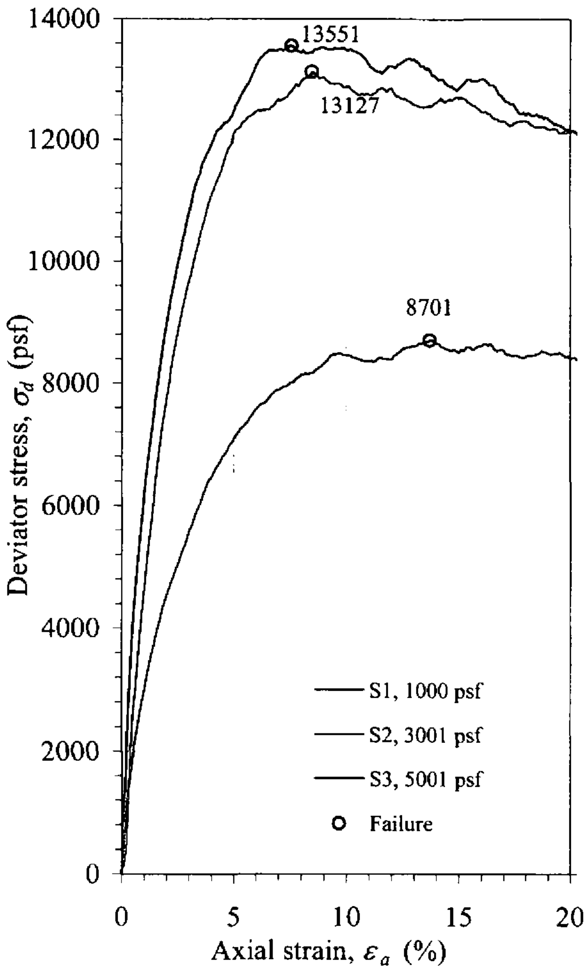
Consolidated Undrained Triaxial Compression Test for Cohesive Soils

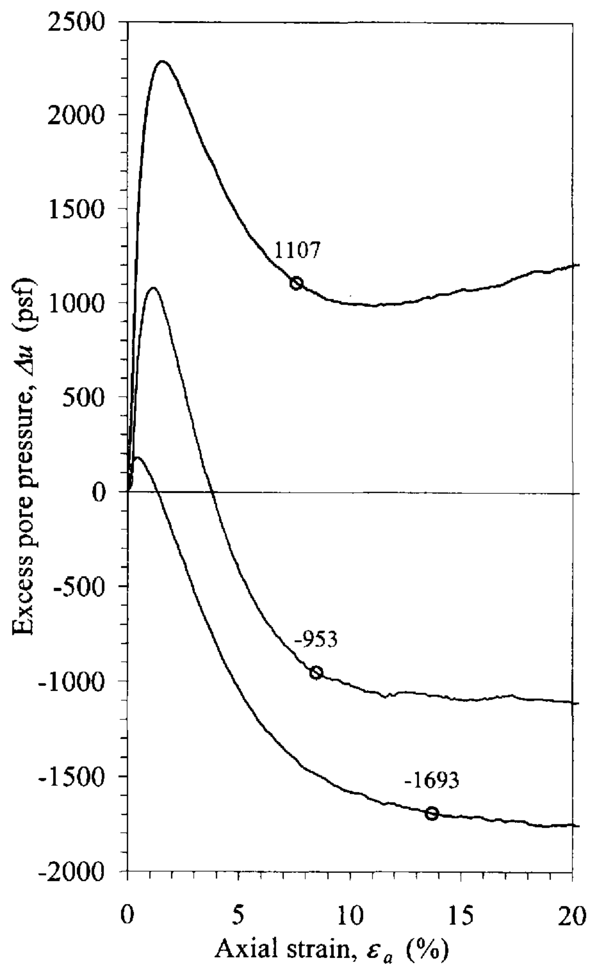
(*ASTM D4767*)

Project: CS Mining - SE Pond
No: 01640-002 (III)
Location: Milford, UT

Boring No.: TP51
Sample:
Depth: 4-5'

	Test Number:	S1	S2	S3
Total stress	σ_3 (psf)	1000	3001	5001
	σ_1-σ_3 (psf)	8701	13127	13551
	σ_1 (psf)	9700	16127	18552
	$q = (\sigma_1 - \sigma_3)/2$ (psf)	4350	6563	6776
	$p = (\sigma_1 + \sigma_3)/2$ (psf)	5350	9564	11777
Effective stress	Δu (psf)	-1693	-953	1107
	σ'_3 (psf)	2693	3954	3894
	σ'_1-σ'_3 (psf)	8701	13127	13551
	σ'_1 (psf)	11393	17080	17446
	$q = (\sigma'_1 - \sigma'_3)/2$ (psf)	4350	6563	6776
	$p' = (\sigma'_1 + \sigma'_3)/2$ (psf)	7043	10517	10670
	σ'_1/σ'_3	4.23	4.32	4.48
	$A = \Delta u/(\sigma_1 - \sigma_3)$	-0.195	-0.073	0.082





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Consolidated Undrained Triaxial Compression Test for Cohesive Soils

(*ASTM D4767*)

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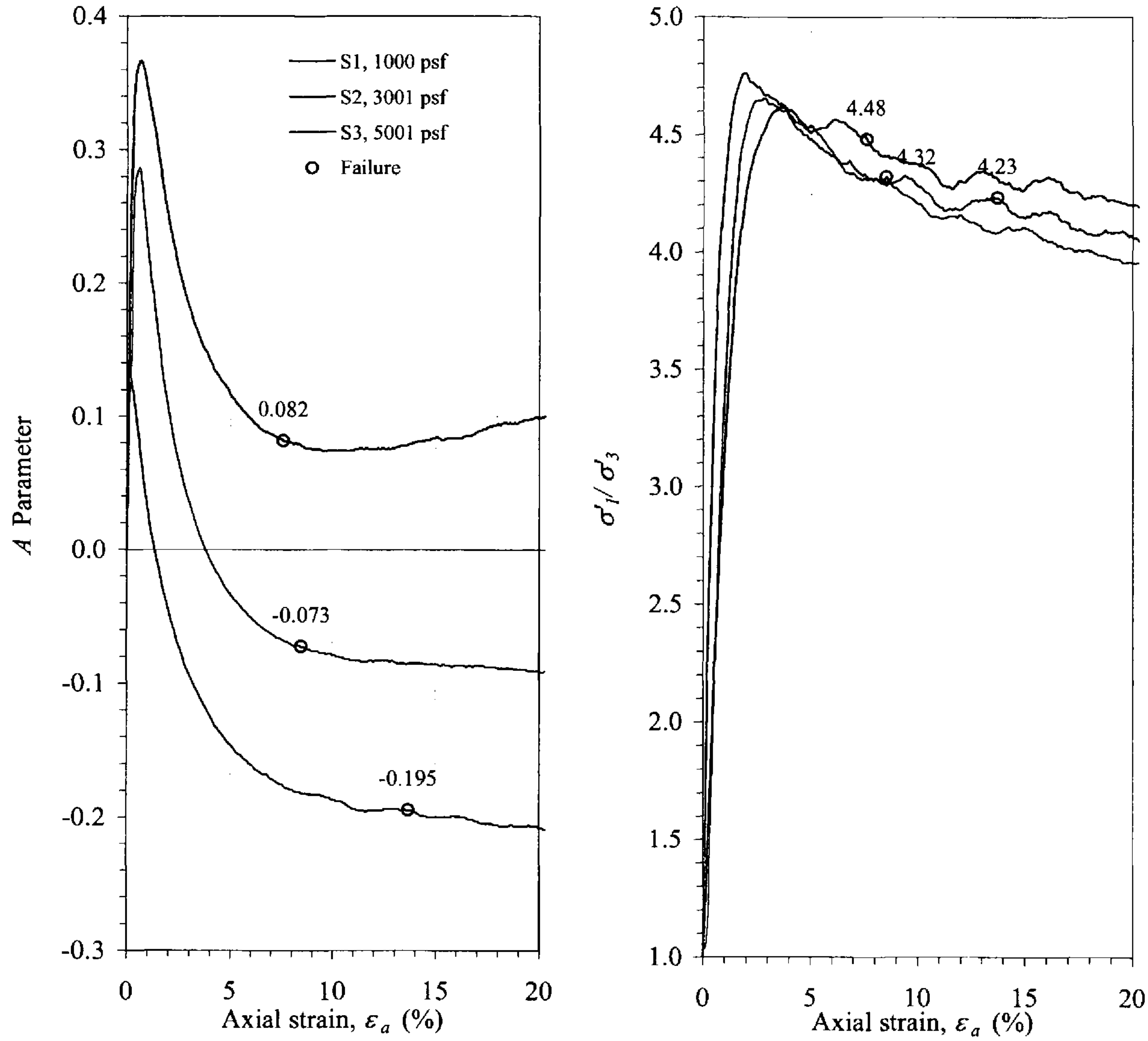
Project: CS Mining - SE Pond
No: 01640-002 (III)
Location: Milford, UT

Boring No.: TP51
Sample:
Depth: 4-5'

Summary of strength parameters at peak deviator stress		
Total stress	c (psf)	2577
	ϕ (deg)	23.4
Effective stress	c' (psf)	0
	ϕ' (deg)	38.9



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Consolidated Undrained Triaxial Compression Test for Cohesive Soils

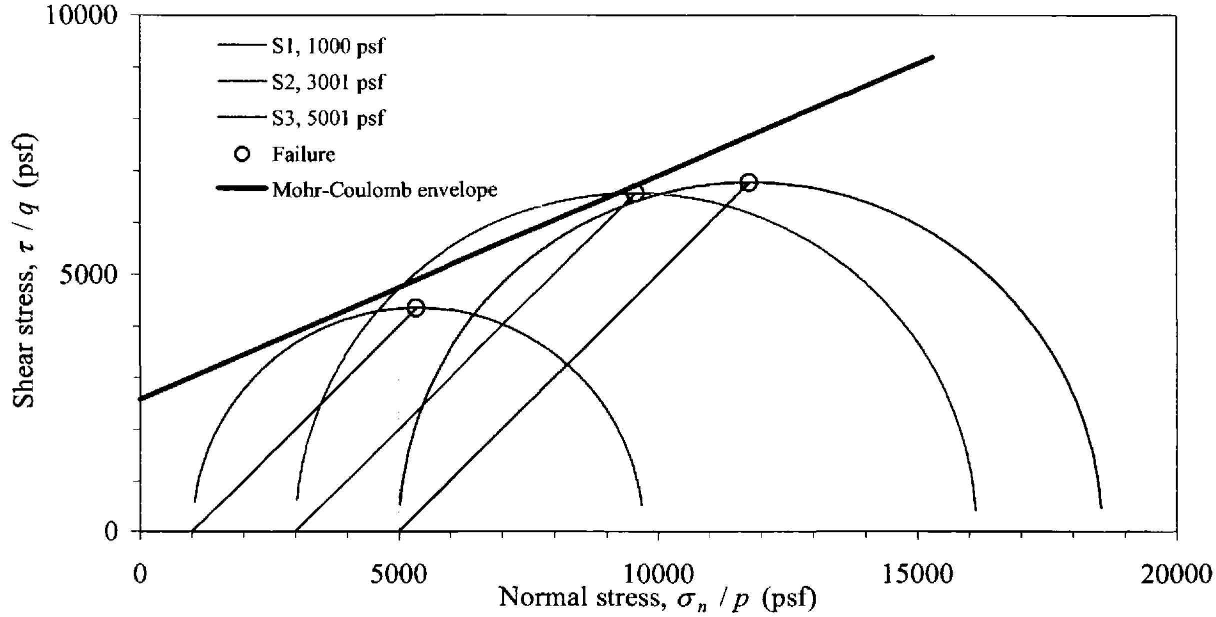
(*ASTM D4767*)

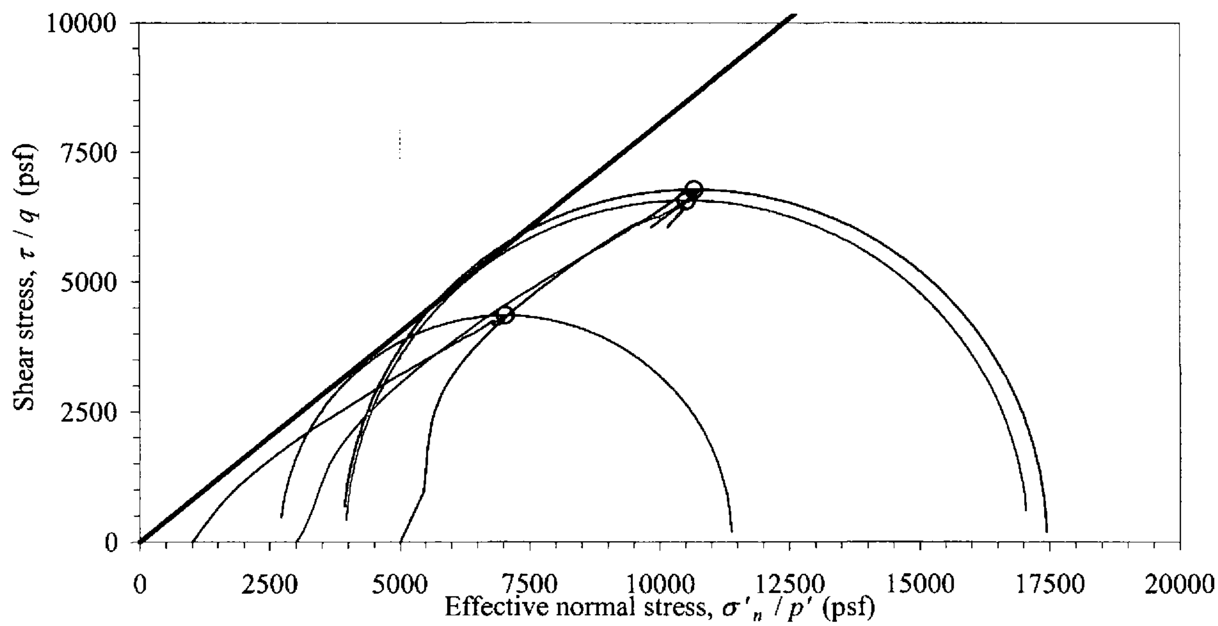
IGES

Project: CS Mining - SE Pond
No: 01640-002 (III)
Location: Milford, UT

Boring No.: TP51
Sample:
Depth: 4-5'

Summary of strength parameters at peak deviator stress		
Total stress	c (psf)	2577
	ϕ (deg)	23.4
Effective stress	c' (psf)	0
	ϕ' (deg)	38.9





Z:\PROJECTS\01640_CS_mining\002_SW_Facility\III\[GTXCU3v2_TP51_4-5.xls]Summary

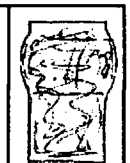
Consolidated Undrained Triaxial Compression Test for Cohesive Soils

(*ASTM D4767*)

IGES

Project: **CS Mining - SE Pond**
No: **01640-002 (III)**
Location: Milford, UT
Date: 9/18/2013
By: MP

Boring No.: **TP52**
Sample:
Depth: **4-5'**
Sample Description: Light brown sand with silt and gravel
Engineering Classification: Not requested
Sample type: Laboratory compacted

	Test Number:	S1	S2	S3
Initial	Height, H (in)	5.990	6.007	5.983
	Diameter, D (in)	2.414	2.413	2.416
	Water content, w (%)	10.6	10.6	10.6
	Dry unit weight, γ_d (pcf)	113.5	113.3	113.4
	Saturation (%)	61.5	61.2	61.3
	Void ratio, e	0.46	0.46	0.46
	Mounting	Wet	Wet	Wet
Before shear	Water content, w (%)	16.2	16.1	16.0
	Dry unit weight, γ_d (pcf)	115.7	115.9	116.3
	Saturation[a] (%)	100.0	100.0	100.0
	Void ratio, e	0.43	0.43	0.42
	Area, A_{eoc} (in^2)	4.49	4.46	4.48
	Area method	A	A	A
	B	0.95	0.95	0.95
	t_{50} (min)	0.11	0.14	0.15
	Back pressure (psf)	11952	14110	13392
	Strain rate (%/min)	0.06	0.06	0.06
	Time to failure (min)	238.3	175.0	200.0
	Strain at failure, ε_f (%)	14.30	10.50	12.00
	Filter paper correction	No	No	No
	Membrane correction	Yes	Yes	Yes
Assumed specific gravity	2.65			

[a] Saturation set to 100% for phase calculations

Summary of strength parameters at peak deviator stress		
Total stress	c (psf)	2982
	ϕ (deg)	14.9
Effective stress	c' (psf)	0
	ϕ' (deg)	37.3

Comments:
Test specimens were compacted to 95% of the MDUW at OWC. The maximum dry unit weight and optimum water content obtained from the standard effort compaction test is 118.9 pcf and 11.0% respectively.

Tested by:___________
Reviewed:___________

Z:\PROJECTS\01640_CS_mining\002_SW_Facility\III\[GTXCU3v2_TP52_4-5.xls]Summary

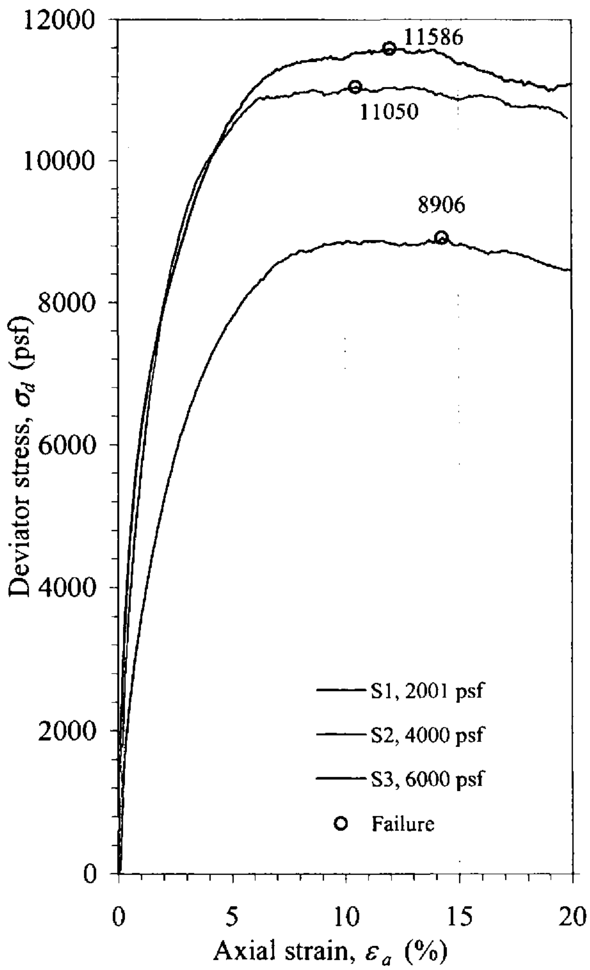
Consolidated Undrained Triaxial Compression Test for Cohesive Soils

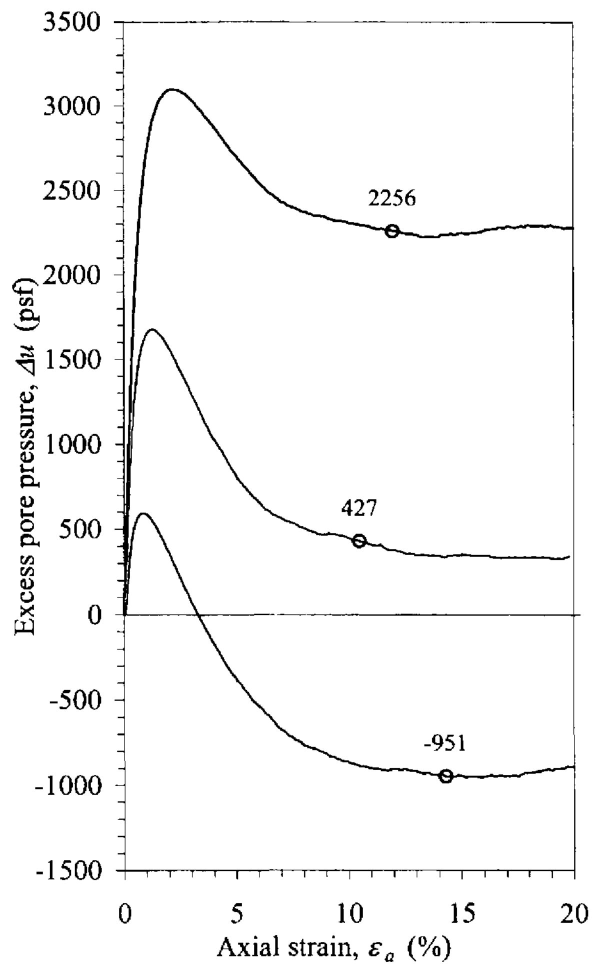
(*ASTM D4767*)

Project: CS Mining - SE Pond
No: 01640-002 (III)
Location: Milford, UT

Boring No.: TP52
Sample:
Depth: 4-5'

	Test Number:	S1	S2	S3
Total stress	σ_3 (psf)	2001	4000	6000
	σ_1-σ_3 (psf)	8906	11050	11586
	σ_1 (psf)	10907	15050	17586
	$q = (\sigma_1 - \sigma_3)/2$ (psf)	4453	5525	5793
	$p = (\sigma_1 + \sigma_3)/2$ (psf)	6454	9525	11793
Effective stress	Δu (psf)	-951	427	2256
	σ'_3 (psf)	2951	3572	3743
	σ'_1-σ'_3 (psf)	8906	11050	11586
	σ'_1 (psf)	11858	14623	15329
	$q = (\sigma'_1 - \sigma'_3)/2$ (psf)	4453	5525	5793
	$p' = (\sigma'_1 + \sigma'_3)/2$ (psf)	7404	9098	9536
	σ'_1/σ'_3	4.02	4.09	4.10
	$A = \Delta u/(\sigma_1 - \sigma_3)$	-0.107	0.039	0.195





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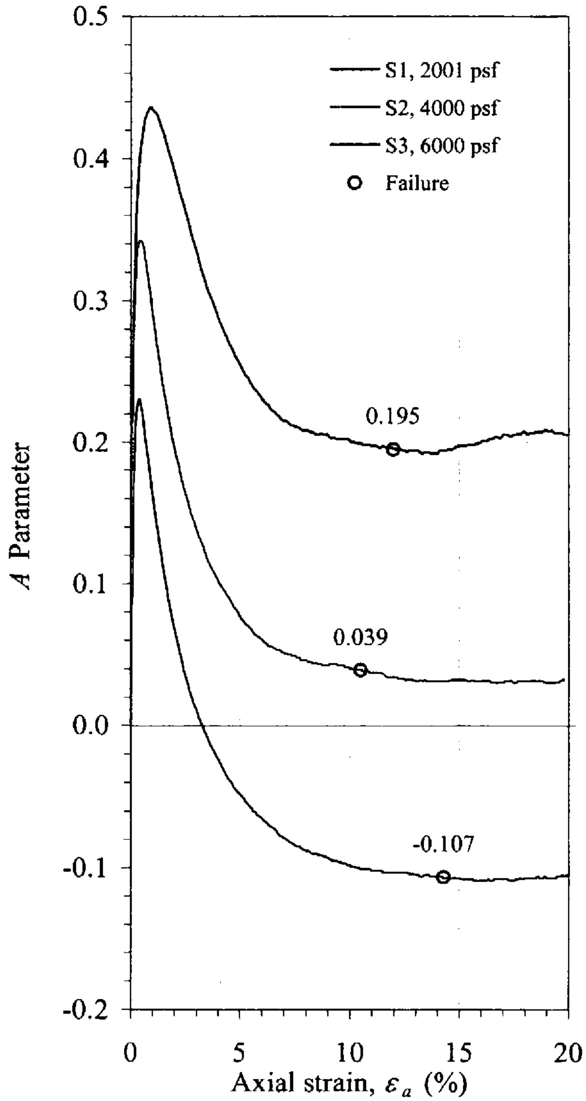
Consolidated Undrained Triaxial Compression Test for Cohesive Soils

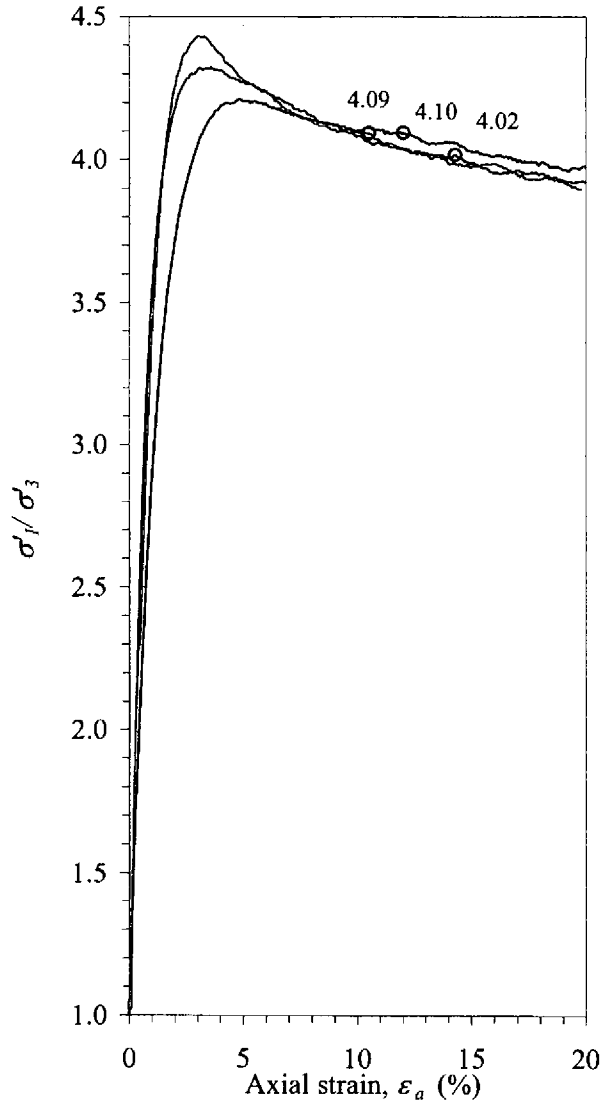
(*ASTM D4767*)

Project: CS Mining - SE Pond
No: 01640-002 (III)
Location: Milford, UT

Boring No.: TP52
Sample:
Depth: 4-5'

Summary of strength parameters at peak deviator stress		
Total stress	c (psf)	2982
	ϕ (deg)	14.9
Effective stress	c' (psf)	0
	ϕ' (deg)	37.3





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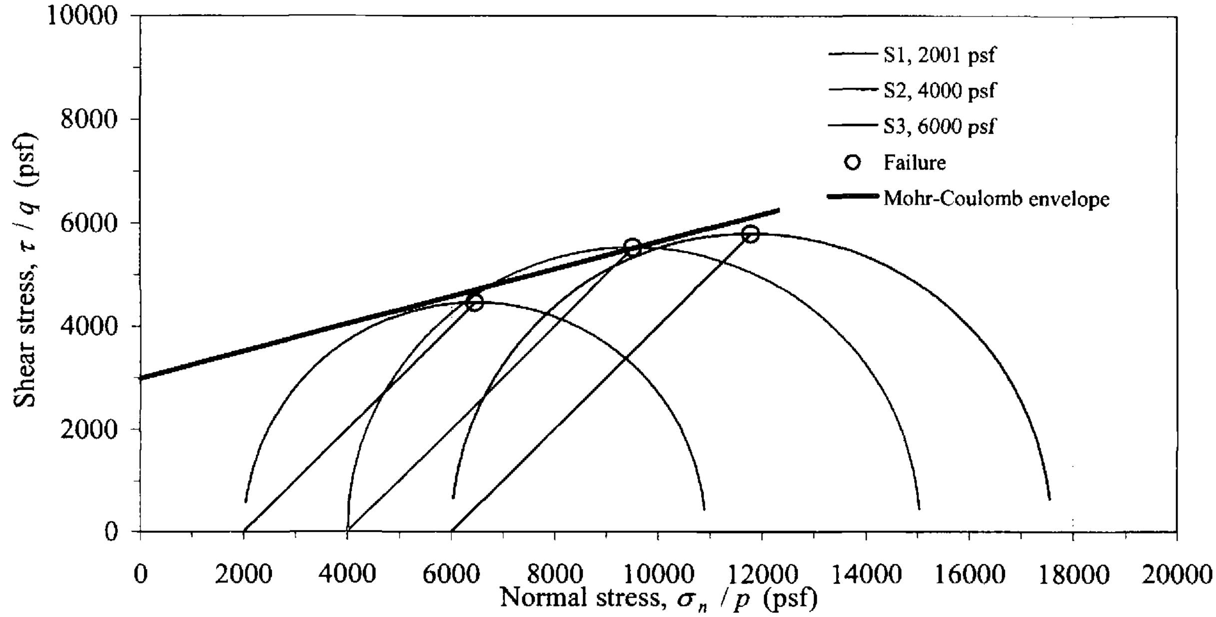
Consolidated Undrained Triaxial Compression Test for Cohesive Soils

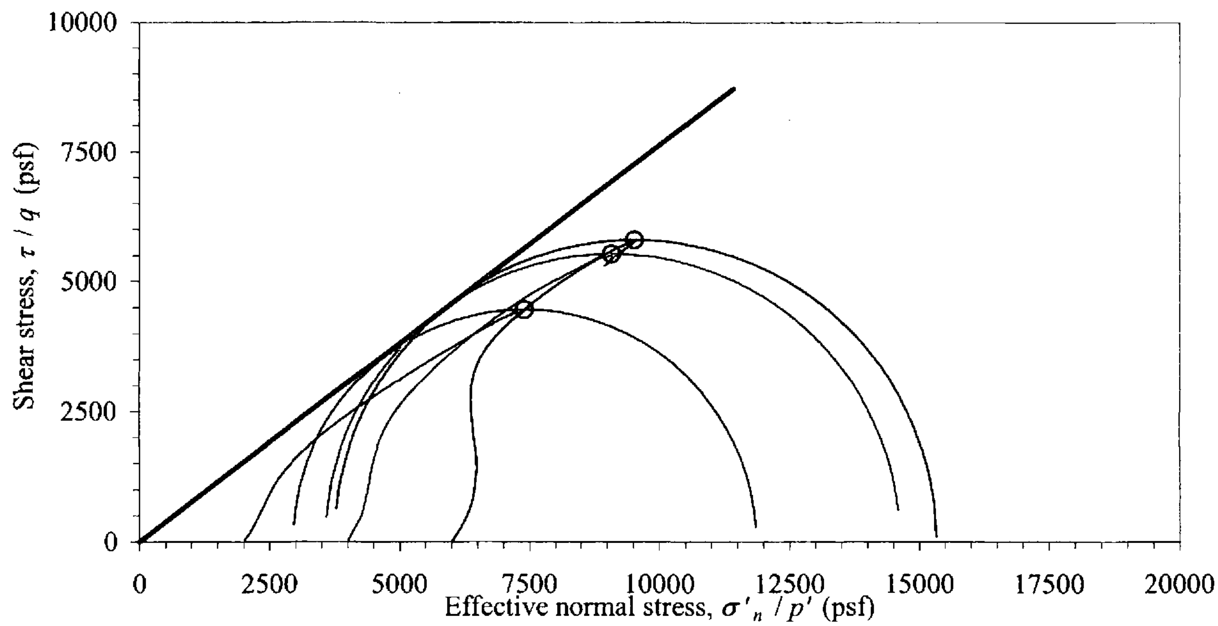
(ASTM D4767)

Project: CS Mining - SE Pond
No: 01640-002 (III)
Location: Milford, UT

Boring No.: TP52
Sample:
Depth: 4-5'

Summary of strength parameters at peak deviator stress		
Total stress	c (psf)	2982
	ϕ (deg)	14.9
Effective stress	c' (psf)	0
	ϕ' (deg)	37.3





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Direct Shear Test for Soils Under Drained Conditions

(ASTM D3080)

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Project: CS Mining - SE Pond
No: 01640-002 (III)
Location: Milford, UT
Date: 9/18/2013
By: JDF

Boring No.: TP51
Sample:
Depth: 4-5'
Sample Description: Brown sand with silt and gravel
Sample type: Laboratory compacted
Dry unit weight 110.8 pcf
at 12.9 (%) w
Compaction specifications: 95% of ASTM D698B

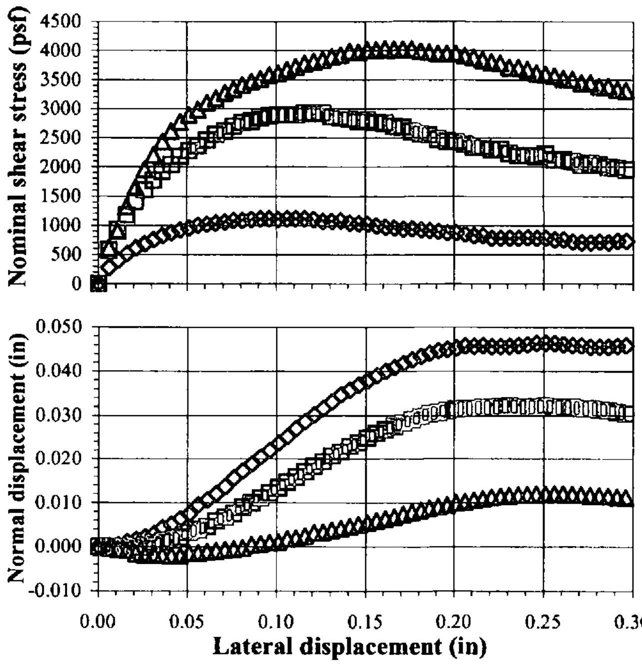
Test type: Inundated
Lateral displacement (in.): 0.3
Shear rate (in./min): 0.0172
Specific gravity, Gs: 2.65 Assumed

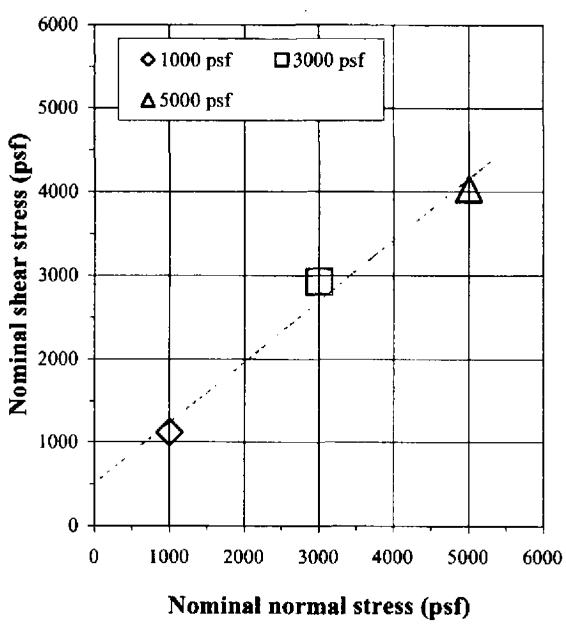
	Sample 1		Sample 2		Sample 3	
Nominal normal stress (psf)	1000		3000		5000	
Peak shear stress (psf)	1116		2928		4032	
Lateral displacement at peak (in)	0.091		0.121		0.161	
	Initial	Pre-shear	Initial	Pre-shear	Initial	Pre-shear
Sample height (in)	1.0000	0.9767	1.0000	0.9683	1.0000	0.9713
Sample diameter (in)	2.416	2.416	2.416	2.416	2.416	2.416
Wt. rings + wet soil (g)	193.29	199.45	193.17	198.70	197.18	202.93
Wt. rings (g)	42.66	42.66	42.54	42.54	46.55	46.55
Wet soil + tare (g)	477.56		477.56		477.56	
Dry soil + tare (g)	440.26		440.26		440.26	
Tare (g)	140.31		140.31		140.31	
Water content (%)	12.4	17.0	12.4	16.6	12.4	16.7
Dry unit weight (pcf)	111.3	113.9	111.3	114.9	111.3	114.6
Void ratio, e, for assumed Gs	0.49	0.45	0.49	0.44	0.49	0.44
Saturation (%)*	67.8	100.0	67.8	100.0	67.8	100.0

ϕ' (deg)	36
c' (psf)	505

Average of 3 samples	Initial	Pre-shear
Water content (%)	12.4	16.8
Dry unit weight (pcf)	111.3	114.5

*Pre-shear saturation set to 100% for phase calculations





Entered by:__________
Reviewed:__________

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Direct Shear Test for Soils Under Drained Conditions

(ASTM D3080)

Project: CS Mining - SE Pond
No: 01640-002 (III)
Location: Milford, UT

Boring No.: TP51
Sample:
Depth: 4-5'

Nominal normal stress = 1000 psf			Nominal normal stress = 3000 psf			Nominal normal stress = 5000 psf		
Lateral Displacement (in.)	Nominal Shear Stress (psf)	Normal Displacement (in.)	Lateral Displacement (in.)	Nominal Shear Stress (psf)	Normal Displacement (in.)	Lateral Displacement (in.)	Nominal Shear Stress (psf)	Normal Displacement (in.)
0.000	0	0.000	0.000	0	0.000	0.000	0	0.000
0.006	276	0.000	0.006	576	0.000	0.006	612	0.000
0.011	396	0.000	0.011	924	0.000	0.011	900	-0.001
0.016	516	0.001	0.016	1164	0.000	0.016	1320	-0.001
0.021	612	0.002	0.021	1404	0.000	0.021	1644	-0.002
0.026	684	0.002	0.026	1596	0.000	0.026	1956	-0.002
0.031	756	0.003	0.031	1764	0.001	0.031	2208	-0.002
0.036	828	0.004	0.036	1920	0.001	0.036	2436	-0.002
0.041	876	0.005	0.041	2040	0.002	0.041	2616	-0.002
0.046	924	0.006	0.046	2184	0.002	0.046	2772	-0.002
0.051	960	0.008	0.051	2280	0.003	0.051	2892	-0.001
0.056	1008	0.010	0.056	2364	0.004	0.056	2988	-0.001
0.061	1020	0.011	0.061	2460	0.005	0.061	3108	-0.001
0.066	1044	0.012	0.066	2556	0.006	0.066	3180	-0.001
0.071	1056	0.014	0.071	2616	0.007	0.071	3276	-0.001
0.076	1092	0.016	0.076	2700	0.008	0.076	3336	-0.001
0.081	1092	0.017	0.081	2760	0.009	0.081	3408	0.000
0.086	1104	0.019	0.086	2784	0.010	0.086	3468	0.001
0.091	1116	0.021	0.091	2844	0.011	0.091	3516	0.001
0.096	1116	0.022	0.096	2880	0.012	0.096	3576	0.001
0.101	1104	0.024	0.101	2892	0.014	0.101	3612	0.001
0.106	1116	0.025	0.106	2892	0.015	0.106	3672	0.002
0.111	1116	0.027	0.111	2892	0.016	0.111	3720	0.002
0.116	1116	0.029	0.116	2916	0.017	0.116	3780	0.003
0.121	1104	0.030	0.121	2928	0.018	0.121	3816	0.003
0.126	1068	0.032	0.126	2916	0.019	0.126	3840	0.003
0.131	1068	0.033	0.131	2868	0.021	0.131	3900	0.004
0.136	1080	0.035	0.136	2844	0.022	0.136	3924	0.004
0.141	1044	0.036	0.141	2820	0.023	0.141	3984	0.005
0.146	1032	0.037	0.146	2784	0.024	0.146	3972	0.005
0.151	1020	0.038	0.151	2796	0.025	0.151	4008	0.006
0.156	996	0.039	0.156	2760	0.026	0.156	4008	0.006
0.161	972	0.040	0.161	2748	0.027	0.161	4032	0.006
0.166	960	0.041	0.166	2700	0.028	0.166	4020	0.007
0.171	936	0.042	0.171	2676	0.028	0.171	4020	0.007
0.176	936	0.043	0.176	2604	0.029	0.176	4020	0.008
0.181	924	0.043	0.181	2568	0.030	0.181	3984	0.008
0.186	912	0.044	0.186	2544	0.030	0.186	3972	0.009
0.191	900	0.045	0.191	2472	0.031	0.191	3948	0.009
0.196	876	0.045	0.196	2448	0.031	0.196	3948	0.010
0.201	876	0.045	0.201	2436	0.032	0.201	3948	0.010
0.206	852	0.046	0.206	2388	0.032	0.206	3912	0.010
0.211	828	0.046	0.211	2340	0.032	0.211	3888	0.011
0.216	828	0.046	0.216	2340	0.032	0.216	3840	0.011
0.221	780	0.046	0.221	2292	0.032	0.221	3804	0.011
0.226	780	0.046	0.226	2304	0.032	0.226	3780	0.012
0.231	780	0.046	0.231	2232	0.032	0.231	3708	0.012
0.236	780	0.046	0.236	2196	0.032	0.236	3708	0.012
0.241	792	0.046	0.241	2196	0.032	0.241	3672	0.012
0.246	780	0.046	0.246	2184	0.032	0.246	3612	0.012
0.251	780	0.046	0.251	2220	0.032	0.251	3588	0.012
0.256	756	0.046	0.256	2124	0.032	0.256	3564	0.012
0.261	756	0.046	0.261	2124	0.032	0.261	3516	0.012
0.266	720	0.046	0.266	2088	0.032	0.266	3504	0.012
0.271	708	0.046	0.271	2040	0.032	0.271	3444	0.012
0.276	708	0.046	0.276	2064	0.032	0.276	3444	0.012
0.281	720	0.046	0.281	2040	0.031	0.281	3384	0.012
0.286	708	0.046	0.286	1992	0.031	0.286	3384	0.012
0.291	732	0.046	0.291	1980	0.031	0.291	3324	0.011
0.296	732	0.046	0.296	1956	0.030	0.296	3312	0.011
0.301	708	0.046	0.301	1944	0.030	0.301	3312	0.011

Direct Shear Test for Soils Under Drained Conditions

(ASTM D3080)

Project: CS Mining - SE Pond
No: 01640-002 (III)
Location: Milford, UT
Date: 9/18/2013
By: JDF

Boring No.: TP52
Sample:
Depth: 4-5'
Sample Description: Brown sand
Sample type: Laboratory compacted
Dry unit weight 113 pcf
at 11 (%) w
Compaction specifications: 95% of ASTM D698B

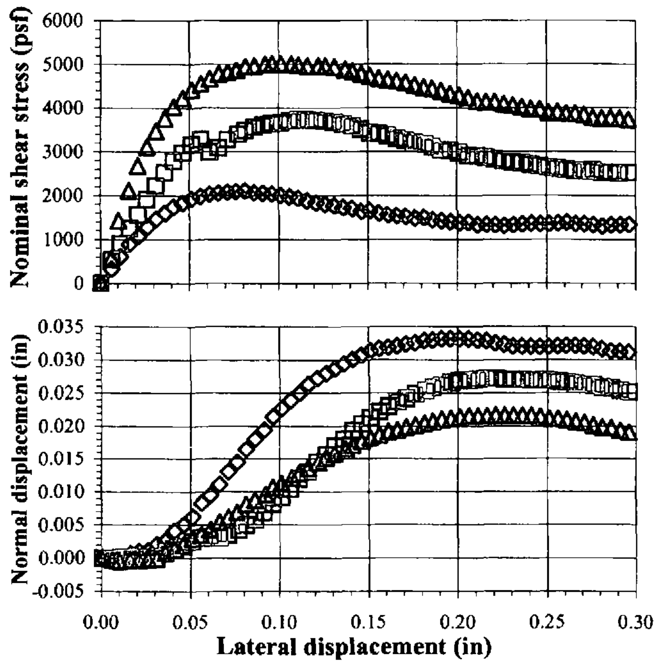
Test type: Inundated
Lateral displacement (in.): 0.3
Shear rate (in./min): 0.0200
Specific gravity, Gs: 2.65 Assumed

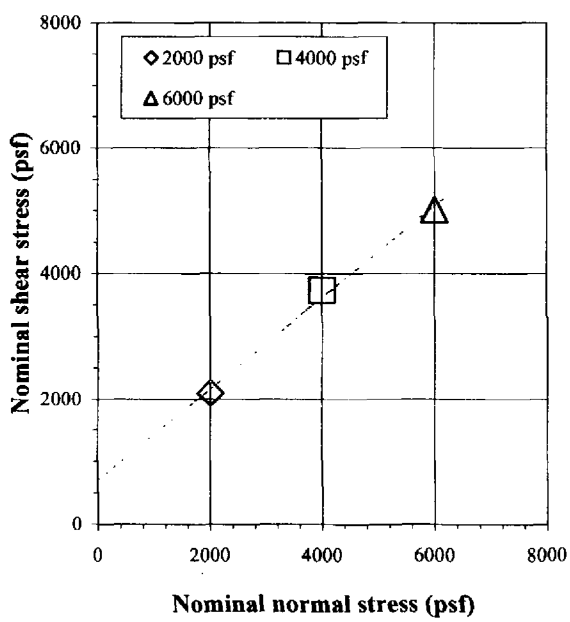
	Sample 1		Sample 2		Sample 3	
Nominal normal stress (psf)	2000		4000		6000	
Peak shear stress (psf)	2100		3732		5016	
Lateral displacement at peak (in)	0.081		0.111		0.096	
	Initial	Pre-shear	Initial	Pre-shear	Initial	Pre-shear
Sample height (in)	1.0000	0.9864	1.0000	0.9774	1.0000	0.9783
Sample diameter (in)	2.416	2.416	2.416	2.416	2.416	2.416
Wt. rings + wet soil (g)	193.33	201.41	193.97	201.38	193.56	201.03
Wt. rings (g)	42.31	42.31	42.95	42.95	42.54	42.54
Wet soil + tare (g)	746.88		746.88		746.88	
Dry soil + tare (g)	690.53		690.53		690.53	
Tare (g)	160.19		160.19		160.19	
Water content (%)	10.6	16.5	10.6	16.1	10.6	16.1
Dry unit weight (pcf)	113.4	115.0	113.4	116.0	113.4	115.9
Void ratio, e, for assumed Gs	0.46	0.44	0.46	0.43	0.46	0.43
Saturation (%)*	61.4	100.0	61.4	100.0	61.4	100.0

ϕ' (deg)	36
c' (psf)	700

Average of 3 samples	Initial	Pre-shear
Water content (%)	10.6	16.2
Dry unit weight (pcf)	113.4	115.6

*Pre-shear saturation set to 100% for phase calculations





Entered by:___________
Reviewed:___________

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Direct Shear Test for Soils Under Drained Conditions

(ASTM D3080)

IGES

Project: CS Mining - SE Pond
No: 01640-002 (III)
Location: Milford, UT

Boring No.: TP52
Sample:
Depth: 4-5'

Nominal normal stress = 2000 psf			Nominal normal stress = 4000 psf			Nominal normal stress = 6000 psf		
Lateral Displacement (in.)	Nominal Shear Stress (psf)	Normal Displacement (in.)	Lateral Displacement (in.)	Nominal Shear Stress (psf)	Normal Displacement (in.)	Lateral Displacement (in.)	Nominal Shear Stress (psf)	Normal Displacement (in.)
0.000	0 0	0.000	0.000	0 0	0.000	0.000	0	0.000
0.006	324	0.000	0.006	540	0.000	0.006	576	0.000
0.011	612	0.000	0.011	900	0.000	0.010	1428	0.000
0.016	888	0.001	0.016	1248	0.000	0.016	2112	0.000
0.021	1068	0.001	0.021	1560	0.000	0.021	2676	0.000
0.026	1284	0.001	0.026	1908	0.000	0.026	3108	0.000
0.031	1464	0.002	0.031	2220	0.000	0.031	3468	0.000
0.036	1596	0.003	0.036	2520	0.001	0.036	3756	0.001
0.041	1740	0.004	0.041	2784	0.002	0.041	4032	0.001
0.046	1824	0.005	0.046	2976	0.002	0.046	4224	0.002
0.051	1920	0.006	0.051	3156	0.003	0.051	4416	0.003
0.056	1980	0.008	0.056	3276	0.003	0.056	4548	0.004
0.061	2028	0.010	0.061	2988	0.003	0.061	4668	0.004
0.066	2052	0.011	0.066	3084	0.003	0.066	4776	0.005
0.071	2076	0.013	0.071	3276	0.004	0.071	4812	0.006
0.076	2088	0.015	0.077	3396	0.004	0.076	4860	0.007
0.081	2100	0.017	0.081	3480	0.005	0.081	4944	0.008
0.086	2064	0.018	0.086	3552	0.006	0.086	4956	0.009
0.091	2052	0.020	0.091	3612	0.007	0.092	4992	0.010
0.096	2040	0.022	0.096	3648	0.008	0.096	5016	0.011
0.101	2004	0.023	0.101	3660	0.009	0.101	5016	0.011
0.106	1968	0.024	0.106	3708	0.010	0.107	5004	0.012
0.111	1932	0.025	0.111	3732	0.012	0.111	4980	0.013
0.116	1884	0.026	0.116	3732	0.013	0.116	4968	0.014
0.121	1836	0.027	0.121	3720	0.015	0.122	4968	0.014
0.126	1812	0.028	0.126	3696	0.016	0.126	4956	0.015
0.131	1764	0.029	0.131	3672	0.017	0.131	4944	0.016
0.136	1728	0.029	0.136	3636	0.018	0.137	4884	0.017
0.141	1704	0.030	0.141	3588	0.019	0.141	4848	0.017
0.146	1644	0.031	0.146	3516	0.020	0.146	4788	0.018
0.151	1656	0.031	0.151	3432	0.021	0.151	4728	0.018
0.156	1596	0.032	0.156	3408	0.022	0.156	4680	0.019
0.161	1560	0.032	0.161	3360	0.023	0.161	4644	0.019
0.166	1536	0.032	0.166	3300	0.024	0.166	4620	0.020
0.171	1524	0.032	0.171	3252	0.024	0.171	4584	0.020
0.176	1488	0.033	0.176	3216	0.025	0.176	4524	0.020
0.181	1500	0.033	0.182	3168	0.025	0.181	4476	0.021
0.186	1452	0.033	0.186	3108	0.026	0.186	4440	0.021
0.191	1428	0.033	0.191	3036	0.026	0.191	4392	0.021
0.196	1404	0.033	0.196	3024	0.027	0.196	4332	0.021
0.201	1380	0.033	0.201	2976	0.027	0.201	4296	0.021
0.206	1392	0.033	0.206	2916	0.027	0.206	4236	0.022
0.211	1344	0.033	0.211	2904	0.027	0.211	4164	0.022
0.216	1344	0.033	0.216	2868	0.027	0.216	4140	0.022
0.221	1332	0.033	0.221	2832	0.027	0.221	4140	0.022
0.226	1320	0.032	0.226	2796	0.027	0.226	4092	0.022
0.231	1332	0.032	0.231	2760	0.027	0.231	4056	0.022
0.236	1356	0.032	0.236	2748	0.027	0.236	4020	0.022
0.241	1368	0.032	0.241	2700	0.027	0.241	3984	0.022
0.246	1356	0.032	0.246	2676	0.027	0.246	3972	0.022
0.251	1356	0.032	0.251	2640	0.027	0.251	3888	0.021
0.256	1368	0.032	0.256	2616	0.027	0.256	3912	0.021
0.261	1392	0.032	0.261	2592	0.027	0.261	3876	0.021
0.266	1356	0.032	0.266	2568	0.027	0.266	3876	0.021
0.271	1356	0.032	0.271	2556	0.026	0.271	3852	0.021
0.276	1332	0.032	0.276	2580	0.026	0.276	3780	0.020
0.281	1308	0.032	0.281	2532	0.026	0.281	3768	0.020
0.286	1332	0.031	0.286	2532	0.026	0.286	3780	0.020
0.291	1332	0.031	0.291	2508	0.025	0.291	3756	0.019
0.296	1344	0.031	0.296	2520	0.025	0.296	3732	0.019
0.301	1308	0.031	0.301	2508	0.025	0.301	3756	0.019

Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter, Method C (ASTM D5084)

IGES

Project: CS Mining - SE Pond
No: 01640-002 (III)
Location: Milford, UT
Date: 9/4/2013
By: MP

Boring No.: TP41
Sample:
Depth: 4-6'
Sample Description: Light brown clayey sand
Sample Type: Laboratory Compacted
Compaction Specifications: 95 (%) Dry unit weight at 16.5 (%) w

	Initial (o)	Final (f)
Sample Height, H (in)	3.009	3.000
Sample Diameter, D (in)	2.412	2.39
Sample Length, L (cm)	7.643	7.620
Sample Area, A (cm^2)	29.479	29.037
Sample Volume, V (cm^3)	225.30	221.26
Wt. Rings + Wet Soil (g)	431.49	Multi-staged
Wt. Rings (g)	0	
Wet Unit Wt., γ_m (pcf)	119.6	
Wet Soil + Tare (g)	310.06	
Dry Soil + Tare (g)	284.01	
Tare (g)	126.38	
Weight of solids, Ws (g)	370.29	
Water Content, w (%)	16.53	
Dry Unit Wt, γ_d (pcf)	102.6	
Void ratio, e, for assumed Gs	0.61	
Saturation (%), for assumed Gs	71.5	
Average K[b] (cm/sec)	**1.9E-04**	

[a] Saturation set to 100% for phase calculations
[b] K corrected to 20°C

Optimum water content (%)	16.5	
Maximum dry unit weight (pcf)	107.9	
Gs	2.65	Assumed
Cell No.	T3	
Station No.	4	
Permeant liquid used	De-aired tap water	
Total backpressure (psi)	34.5	
Effective horiz. consolidation stress (psi)	6.9	
Effective vert. consolidation stress (psi)	6.9	

	Initial (o)	Final (f)
B value	0.66	0.96
External Burette (cm^3)	16.10	24.50
Cell Pressure (psi)	0.0	41.4

Backpressure bottom (psi)	34.5
Backpressure top (psi)	34.5
System volume coefficient (cm^3/psi)	0.105
System volume change (cm^3)	4.36
Net sample volume change (cm^3)	-4.04
Bottom burette ground length, l_b (cm)	81.90
Top burette ground length, l_t (cm)	81.98
Burette area, a (cm^2)	0.197
Conversion, reading to cm head (cm/rd)	5.076

Start Date and Time: 8/28/13 11:10

Elapsed time (sec)	Bottom Burette (cm^3)	Top Burette (cm^3)	h_1 (cm)	h_2 (cm)	K (cm/sec)	Temp (°C)	Visc. Ratio R_f	K[b] (cm/sec)
180.0	0.00 3.90	10.00 6.12	50.68	11.19	2.2E-04	24.2	0.90	2.0E-04
180.0	0.00 3.90	10.00 6.10	50.68	11.09	2.2E-04	24.7	0.89	2.0E-04
180.0	0.00 3.92	10.00 6.08	50.68	10.88	2.2E-04	25.1	0.89	2.0E-04
180.0	0.00 3.90	10.00 6.08	50.68	10.99	2.2E-04	26.1	0.87	1.9E-04

Entered by:__________
Reviewed:__________

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Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter, Method C (ASTM D5084)

IGES

Project: CS Mining - SE Pond
No: 01640-002 (III)
Location: Milford, UT
Date: 9/4/2013
By: MP

Boring No.: TP41
Sample:
Depth: 4-6'
Sample Description: Light brown clayey sand
Sample Type: Laboratory Compacted
Compaction Specifications: 95 (%) Dry unit weight at 16.5 (%) w

	Initial (o)	Final (f)
Sample Height, H (in)	3.009	2.992
Sample Diameter, D (in)	2.412	2.38
Sample Length, L (cm)	7.643	7.601
Sample Area, A (cm^2)	29.479	28.659
Sample Volume, V (cm^3)	225.30	217.83
Wt. Rings + Wet Soil (g)	431.49	Multi-staged
Wt. Rings (g)	0	
Wet Unit Wt., γ_m (pcf)	119.6	
Wet Soil + Tare (g)	310.06	
Dry Soil + Tare (g)	284.01	
Tare (g)	126.38	
Weight of solids, Ws (g)	370.29	
Water Content, w (%)	16.53	
Dry Unit Wt, γ_d (pcf)	102.6	
Void ratio, e, for assumed Gs	0.61	
Saturation (%), for assumed Gs	71.5	
Average K[b] (cm/sec)	**1.6E-04**	

[a] Saturation set to 100% for phase calculations
[b] K corrected to 20°C

Optimum water content (%)	16.5	
Maximum dry unit weight (pcf)	107.9	
Gs	2.65	Assumed
Cell No.	T3	
Station No.	4	
Permeant liquid used	De-aired tap water	
Total backpressure (psi)	34.5	
Effective horiz. consolidation stress (psi)	20.8	
Effective vert. consolidation stress (psi)	20.8	

	Initial (o)	Final (f)
B value	0.66	0.96
External Burette (cm^3)	16.10	29.40
Cell Pressure (psi)	0.0	55.3

Backpressure bottom (psi)	34.5
Backpressure top (psi)	34.5
System volume coefficient (cm^3/psi)	0.105
System volume change (cm^3)	5.82
Net sample volume change (cm^3)	-7.48
Bottom burette ground length, l_b (cm)	81.90
Top burette ground length, l_t (cm)	81.98
Burette area, a (cm^2)	0.197
Conversion, reading to cm head (cm/rd)	5.076

Start Date and Time: 8/29/13 8:53

Elapsed time (sec)	Bottom Burette (cm^3)	Top Burette (cm^3)	h_1 (cm)	h_2 (cm)	K (cm/sec)	Temp (°C)	Visc. Ratio R_f	K[b] (cm/sec)
180.0	0.00 3.50	10.00 6.45	50.68	14.89	1.8E-04	24.0	0.91	1.6E-04
180.0	0.00 3.50	10.00 6.50	50.68	15.15	1.8E-04	24.0	0.91	1.6E-04
180.0	0.00 3.51	10.00 6.49	50.68	15.05	1.8E-04	24.0	0.91	1.6E-04
180.0	0.00 3.52	10.00 6.48	50.68	14.95	1.8E-04	24.0	0.91	1.6E-04

Entered by:__________
Reviewed:__________

Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter, Method C (ASTM D5084)

IGES

Project: CS Mining - SE Pond
No: 01640-002 (III)
Location: Milford, UT
Date: 9/4/2013
By: MP

Boring No.: TP41
Sample:
Depth: 4-6'
Sample Description: Light brown clayey sand
Sample Type: Laboratory Compacted
Compaction Specifications: 95 (%) Dry unit weight
at 16.5 (%) w

	Initial (o)	Final (f)
Sample Height, H (in)	3.009	2.987
Sample Diameter, D (in)	2.412	2.37
Sample Length, L (cm)	7.643	7.586
Sample Area, A (cm^2)	29.479	28.378
Sample Volume, V (cm^3)	225.30	215.29
Wt. Rings + Wet Soil (g)	431.49	452.74
Wt. Rings (g)	0	0
Wet Unit Wt., γ_m (pcf)	119.6	131.3
Wet Soil + Tare (g)	310.06	574.63
Dry Soil + Tare (g)	284.01	492.26
Tare (g)	126.38	122.37
Weight of solids, Ws (g)	370.29	370.29
Water Content, w (%)	16.53	22.27
Dry Unit Wt, γ_d (pcf)	102.6	107.4
Void ratio, e, for assumed Gs	0.61	0.59
Saturation (%), for assumed Gs	71.5	100 [a]
Average K[b] (cm/sec)	**1.4E-04**	

[a] Saturation set to 100% for phase calculations
[b] K corrected to 20°C

Optimum water content (%)	16.5	
Maximum dry unit weight (pcf)	107.9	
Gs	2.65	Assumed
Cell No.	T3	
Station No.	4	
Permeant liquid used	De-aired tap water	
Total backpressure (psi)	34.5	
Effective horiz. consolidation stress (psi)	34.7	
Effective vert. consolidation stress (psi)	34.7	

	Initial (o)	Final (f)
B value	0.66	0.96
External Burette (cm^3)	16.10	33.40
Cell Pressure (psi)	0.0	69.2

Backpressure bottom (psi)	34.5
Backpressure top (psi)	34.5
System volume coefficient (cm^3/psi)	0.105
System volume change (cm^3)	7.29
Net sample volume change (cm^3)	-10.01
Bottom burette ground length, l_b (cm)	81.90
Top burette ground length, l_t (cm)	81.98
Burette area, a (cm^2)	0.197
Conversion, reading to cm head (cm/rd)	5.076

Start Date and Time: 9/3/13 13:45

Elapsed time (sec)	Bottom Burette (cm^3)	Top Burette (cm^3)	h_1 (cm)	h_2 (cm)	K (cm/sec)	Temp (°C)	Visc. Ratic R_f	K[b] (cm/sec)
180.0	0.00 3.40	10.00 6.62	50.68	16.27	1.7E-04	27.4	0.84	1.4E-04
180.0	0.00 3.34	10.00 6.64	50.68	16.67	1.6E-04	27.4	0.84	1.4E-04
180.0	0.00 3.32	10.00 6.64	50.68	16.77	1.6E-04	27.4	0.84	1.4E-04
180.0	0.00 3.30	10.00 6.70	50.68	17.18	1.6E-04	27.4	0.84	1.3E-04
180.0	0.00 3.28	10.00 6.72	50.68	17.38	1.6E-04	27.4	0.84	1.3E-04
180.0	0.00 3.30	10.00 6.70	50.68	17.18	1.6E-04	27.4	0.84	1.3E-04

Entered by:__________
Reviewed:__________

Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter, Method C (ASTM D5084)

IGES

Project: CS Mining - SE Pond
No: 01640-002 (III)
Location: Milford, UT
Date: 9/23/2013
By: MP

Boring No.: TP42
Sample:
Depth: 5-6'
Sample Description: Light brown sand with silt
Sample Type: Laboratory Compacted
Compaction Specifications: 95 (%) Dry unit weight at 14 (%) w

	Initial (o)	Final (f)
Sample Height, H (in)	3.000	2.992
Sample Diameter, D (in)	2.416	2.40
Sample Length, L (cm)	7.620	7.599
Sample Area, A (cm^2)	29.577	29.175
Sample Volume, V (cm^3)	225.38	221.71
Wt. Rings + Wet Soil (g)	606.56	Multi-staged
Wt. Rings (g)	145.96	
Wet Unit Wt., γ_m (pcf)	127.6	
Wet Soil + Tare (g)	458.04	
Dry Soil + Tare (g)	417.14	
Tare (g)	127.7	
Weight of solids, Ws (g)	403.57	
Water Content, w (%)	14.13	
Dry Unit Wt, γ_d (pcf)	111.8	
Void ratio, e, for assumed Gs	0.48	
Saturation (%), for assumed Gs	78.0	
Average K[b] (cm/sec)	**4.87E-04**	

[a] Saturation set to 100% for phase calculations
[b] K corrected to 20°C

Optimum water content (%)	14	
Maximum dry unit weight (pcf)	117.7	
Gs	2.65	Assumed
Cell No.	2	
Station No.	3	
Permeant liquid used	De-aired tap water	
Total backpressure (psi)	29.5	
Effective horiz. consolidation stress (psi)	13.9	
Effective vert. consolidation stress (psi)	13.9	

	Initial (o)	Final (f)
B value	0.24	0.96
External Burette (cm^3)	8.00	18.50
Cell Pressure (psi)	0.0	43.4

Backpressure bottom (psi)	29.5
Backpressure top (psi)	29.5
System volume coefficient (cm^3/psi)	0.158
System volume change (cm^3)	6.84
Net sample volume change (cm^3)	-3.66
Bottom burette ground length, l_b (cm)	82.10
Top burette ground length, l_t (cm)	81.9
Burette area, a (cm^2)	0.197
Conversion, reading to cm head (cm/rd)	5.076

Start Date and Time: 9/17/13 11:22

Elapsed time (sec)	Bottom Burette (cm^3)	Top Burette (cm^3)	h_1 (cm)	h_2 (cm)	K (cm/sec)	Temp (°C)	Visc. Ratio R_f	K[b] (cm/sec)
90.0	0.00 4.22	10.00 5.74	50.96	7.92	5.3E-04	23.6	0.92	4.9E-04
90.0	0.00 4.22	10.00 5.76	50.96	8.02	5.3E-04	23.6	0.92	4.8E-04
90.0	0.00 4.20	10.00 5.76	50.96	8.12	5.2E-04	23.6	0.92	4.8E-04
90.0	0.00 4.24	10.00 5.76	50.96	7.92	5.3E-04	23.6	0.92	4.9E-04
90.0	0.00 4.52	10.00 5.98	50.96	7.61	5.4E-04	23.6	0.92	5.0E-04

Entered by:__________
Reviewed:__________

Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter, Method C (ASTM D5084)

IGES

Project: CS Mining - SE Pond
No: 01640-002 (III)
Location: Milford, UT
Date: 9/23/2013
By: MP

Boring No.: TP42
Sample:
Depth: 5-6'
Sample Description: Light brown sand with silt
Sample Type: Laboratory Compacted
Compaction Specifications: 95 (%) Dry unit weight at 14 (%) w

	Initial (o)	Final (f)
Sample Height, H (in)	3.000	2.988
Sample Diameter, D (in)	2.416	2.39
Sample Length, L (cm)	7.620	7.589
Sample Area, A (cm^2)	29.577	28.965
Sample Volume, V (cm^3)	225.38	219.81
Wt. Rings + Wet Soil (g)	606.56	
Wt. Rings (g)	145.96	
Wet Unit Wt., γ_m (pcf)	127.6	
Wet Soil + Tare (g)	458.04	Multi-staged
Dry Soil + Tare (g)	417.14	
Tare (g)	127.7	
Weight of solids, Ws (g)	403.57	
Water Content, w (%)	14.13	
Dry Unit Wt, γ_d (pcf)	111.8	
Void ratio, e, for assumed Gs	0.48	
Saturation (%), for assumed Gs	78.0	
Average K[b] (cm/sec)	**4.81E-04**	

[a] Saturation set to 100% for phase calculations
[b] K corrected to 20°C

Optimum water content (%)	14	
Maximum dry unit weight (pcf)	117.7	
Gs	2.65	Assumed
Cell No.	2	
Station No.	3	
Permeant liquid used	De-aired tap water	
Total backpressure (psi)	29.5	
Effective horiz. consolidation stress (psi)	27.8	
Effective vert. consolidation stress (psi)	27.8	
	Initial (o)	Final (f)
B value	0.24	0.96
External Burette (cm^3)	8.00	22.60
Cell Pressure (psi)	0.0	57.3
Backpressure bottom (psi)	29.5	
Backpressure top (psi)	29.5	
System volume coefficient (cm^3/psi)	0.158	
System volume change (cm^3)	9.03	
Net sample volume change (cm^3)	-5.57	
Bottom burette ground length, l_b (cm)	82.10	
Top burette ground length, l_t (cm)	81.9	
Burette area, a (cm^2)	0.197	
Conversion, reading to cm head (cm/rd)	5.076	

Start Date and Time: 9/18/13 12:14

Elapsed time (sec)	Bottom Burette (cm^3)	Top Burette (cm^3)	h_1 (cm)	h_2 (cm)	K (cm/sec)	Temp (°C)	Visc. Ratio R_f	K[b] (cm/sec)
90.0	0.00 4.12	10.00 5.84	50.96	8.93	5.0E-04	21.6	0.96	4.8E-04
120.0	0.00 4.52	10.00 5.44	50.96	4.87	5.0E-04	21.6	0.96	4.9E-04
125.0	0.00 4.54	10.00 5.40	50.96	4.57	5.0E-04	21.6	0.96	4.8E-04
65.0	0.00 3.60	10.00 6.40	50.96	14.41	5.0E-04	21.6	0.96	4.8E-04

Entered by:__________
Reviewed:__________

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Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter, Method C (ASTM D5084)

IGES

Project: CS Mining - SE Pond
No: 01640-002 (III)
Location: Milford, UT
Date: 9/23/2013
By: MP

Boring No.: TP42
Sample:
Depth: 5-6'
Sample Description: Light brown sand with silt
Sample Type: Laboratory Compacted
Compaction Specifications: 95 (%) Dry unit weight at 14 (%) w

	Initial (o)	Final (f)
Sample Height, H (in)	3.000	2.985
Sample Diameter, D (in)	2.416	2.39
Sample Length, L (cm)	7.620	7.583
Sample Area, A (cm^2)	29.577	28.854
Sample Volume, V (cm^3)	225.38	218.80
Wt. Rings + Wet Soil (g)	606.56	467.12
Wt. Rings (g)	145.96	0
Wet Unit Wt., γ_m (pcf)	127.6	133.3
Wet Soil + Tare (g)	458.04	584.77
Dry Soil + Tare (g)	417.14	522.7
Tare (g)	127.7	128.52
Weight of solids, Ws (g)	403.57	403.57
Water Content, w (%)	14.13	15.75
Dry Unit Wt, γ_d (pcf)	111.8	115.1
Void ratio, e, for assumed Gs	0.48	0.44
Saturation (%), for assumed Gs	78.0	95.6
Average K^b (cm/sec)	**4.70E-04**	

[a] Saturation set to 100% for phase calculations
[b] K corrected to 20°C

Optimum water content (%)	14	
Maximum dry unit weight (pcf)	117.7	
Gs	2.65	Assumed
Cell No.	2	
Station No.	3	
Permeant liquid used	De-aired tap water	
Total backpressure (psi)	29.5	
Effective horiz. consolidation stress (psi)	41.7	
Effective vert. consolidation stress (psi)	41.7	

	Initial (o)	Final (f)
B value	0.24	0.96
External Burette (cm^3)	8.00	25.80
Cell Pressure (psi)	0.0	71.2

Backpressure bottom (psi)	29.5
Backpressure top (psi)	29.5
System volume coefficient (cm^3/psi)	0.158
System volume change (cm^3)	11.22
Net sample volume change (cm^3)	-6.58
Bottom burette ground length, l_b (cm)	82.10
Top burette ground length, l_t (cm)	81.9
Burette area, a (cm^2)	0.197
Conversion, reading to cm head (cm/rd)	5.076

Start Date and Time: 9/19/13 13:27

Elapsed time (sec)	Bottom Burette (cm^3)	Top Burette (cm^3)	h_1 (cm)	h_2 (cm)	K (cm/sec)	Temp (°C)	Visc. Ratio R_t	K^b (cm/sec)
90.0	0.00 4.10	10.00 5.86	50.96	9.13	4.9E-04	21.2	0.97	4.8E-04
90.0	0.00 4.04	10.00 5.92	50.96	9.74	4.8E-04	21.2	0.97	4.6E-04
90.0	0.00 4.06	10.00 5.92	50.96	9.64	4.8E-04	21.2	0.97	4.7E-04
105.0	0.00 4.32	10.00 5.66	50.96	7.00	4.9E-04	21.2	0.97	4.8E-04
75.0	0.00 3.70	10.00 6.30	50.96	13.40	4.6E-04	19.6	1.01	4.7E-04

Entered by:__________
Reviewed:__________

Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter, Method C (ASTM D5084)

IGES

Project: CS Mining - SE Pond
No: 01640-002 (III)
Location: Milford, UT
Date: 9/24/2013
By: MP

Boring No.: TP43
Sample:
Depth: 6-8'
Sample Description: Brown silty sand with gravel
Sample Type: Laboratory Compacted
Compaction Specifications: 95 (%) Dry unit weight
at 11.5 (%) w

	Initial (o)	Final (f)
Sample Height, H (in)	3.014	3.002
Sample Diameter, D (in)	2.408	2.38
Sample Length, L (cm)	7.656	7.626
Sample Area, A (cm^2)	29.381	28.812
Sample Volume, V (cm^3)	224.93	219.73
Wt. Rings + Wet Soil (g)	458.03	Multi-staged
Wt. Rings (g)	0	
Wet Unit Wt., γ_m (pcf)	127.1	
Wet Soil + Tare (g)	493.57	
Dry Soil + Tare (g)	456.61	
Tare (g)	124.11	
Weight of solids, Ws (g)	412.21	
Water Content, w (%)	11.12	
Dry Unit Wt, γ_d (pcf)	114.4	
Void ratio, e, for assumed Gs	0.45	
Saturation (%), for assumed Gs	66.0	
Average K[b] (cm/sec)	**2.5E-04**	

[a] Saturation set to 100% for phase calculations
[b] K corrected to 20°C

Optimum water content (%)	11.5	
Maximum dry unit weight (pcf)	120.2	
Gs	2.65	Assumed
Cell No.	T2	
Station No.	T2	
Permeant liquid used	De-aired tap water	
Total backpressure (psi)	30	
Effective horiz. consolidation stress (psi)	6.9	
Effective vert. consolidation stress (psi)	6.9	

	Initial (o)	Final (f)
B value	0.66	0.98
External Burette (cm^3)	10.10	19.30
Cell Pressure (psi)	0.0	36.9

Backpressure bottom (psi)	30.0
Backpressure top (psi)	30.0
System volume coefficient (cm^3/psi)	0.108
System volume change (cm^3)	4.00
Net sample volume change (cm^3)	-5.20
Bottom burette ground length, l_b (cm)	69.95
Top burette ground length, l_t (cm)	69
Burette area, a (cm^2)	0.873
Conversion, reading to cm head (cm/rd)	1.145

Start Date and Time: 9/16/13 12:37

Elapsed time (sec)	Bottom Burette (cm^3)	Top Burette (cm^3)	h_1 (cm)	h_2 (cm)	K (cm/sec)	Temp (°C)	Visc. Ratio R_f	K[b] (cm/sec)
480.0	1.00 9.00	24.00 16.00	27.29	8.97	2.7E-04	21.4	0.97	2.6E-04
600.0	1.00 9.50	24.00 15.50	27.29	7.82	2.4E-04	21.4	0.97	2.3E-04
600.0	1.00 9.20	24.00 15.90	27.29	8.62	2.2E-04	21.2	0.97	2.2E-04
600.0	1.00 9.90	24.00 15.10	27.29	6.90	2.6E-04	21.0	0.98	2.6E-04
480.0	1.00 9.30	24.00 15.70	27.29	8.28	2.9E-04	21.6	0.96	2.8E-04
540.0	1.00 9.10	24.00 15.90	27.29	8.74	2.4E-04	21.2	0.97	2.4E-04

Entered by:__________
Reviewed:__________

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Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter, Method C (ASTM D5084)

IGES

Project: CS Mining - SE Pond
No: 01640-002 (III)
Location: Milford, UT
Date: 9/24/2013
By: MP

Boring No.: TP43
Sample:
Depth: 6-8'
Sample Description: Brown silty sand with gravel
Sample Type: Laboratory Compacted
Compaction Specifications: 95 (%) Dry unit weight at 11.1 (%) w

	Initial (o)	Final (f)
Sample Height, H (in)	3.014	2.999
Sample Diameter, D (in)	2.408	2.38
Sample Length, L (cm)	7.656	7.618
Sample Area, A (cm^2)	29.381	28.659
Sample Volume, V (cm^3)	224.93	218.33
Wt. Rings + Wet Soil (g)	458.03	
Wt. Rings (g)	0	
Wet Unit Wt., γ_m (pcf)	127.1	Multi-staged
Wet Soil + Tare (g)	493.57	
Dry Soil + Tare (g)	456.61	
Tare (g)	124.11	
Weight of solids, Ws (g)	412.21	
Water Content, w (%)	11.12	
Dry Unit Wt, γ_d (pcf)	114.4	
Void ratio, e, for assumed Gs	0.45	
Saturation (%), for assumed Gs	66.0	
Average K[b] (cm/sec)	**2.1E-04**	

[a] Saturation set to 100% for phase calculations
[b] K corrected to 20°C

Optimum water content (%)	11.5	
Maximum dry unit weight (pcf)	120.2	
Gs	2.65	Assumed
Cell No.	T2	
Station No.	T2	
Permeant liquid used	De-aired tap water	
Total backpressure (psi)	30	
Effective horiz. consolidation stress (psi)	20.8	
Effective vert. consolidation stress (psi)	20.8	

	Initial (o)	Final (f)
B value	0.66	0.98
External Burette (cm^3)	10.10	22.20
Cell Pressure (psi)	0.0	50.8

Backpressure bottom (psi)	30.0
Backpressure top (psi)	30.0
System volume coefficient (cm^3/psi)	0.108
System volume change (cm^3)	5.50
Net sample volume change (cm^3)	-6.60
Bottom burette ground length, l_b (cm)	69.95
Top burette ground length, l_t (cm)	69
Burette area, a (cm^2)	0.873
Conversion, reading to cm head (cm/rd)	1.145

Start Date and Time: 9/20/13 8:43

Elapsed time (sec)	Bottom Burette (cm^3)	Top Burette (cm^3)	h_1 (cm)	h_2 (cm)	K (cm/sec)	Temp (°C)	Visc. Ratio R_f	K[b] (cm/sec)
1260.0	1.00 11.70	24.00 13.20	27.29	2.67	2.1E-04	21.8	0.96	2.1E-04
840.0	1.00 10.80	24.00 14.10	27.29	4.73	2.4E-04	22.3	0.95	2.3E-04
720.0	1.00 10.40	24.00 14.60	27.29	5.76	2.5E-04	23.0	0.93	2.3E-04
900.0	1.00 10.30	24.00 14.70	27.29	5.99	2.0E-04	23.0	0.93	1.8E-04

Entered by:__________
Reviewed:__________

Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter, Method C (ASTM D5084)

IGES

Project: CS Mining - SE Pond
No: 01640-002 (III)
Location: Milford, UT
Date: 9/24/2013
By: MP

Boring No.: TP43
Sample:
Depth: 6-8'

Sample Description: Brown silty sand with gravel
Sample Type: Laboratory Compacted
Compaction Specifications: 95 (%) Dry unit weight at 11.1 (%) w

	Initial (o)	Final (f)
Sample Height, H (in)	3.014	2.996
Sample Diameter, D (in)	2.408	2.37
Sample Length, L (cm)	7.656	7.609
Sample Area, A (cm^2)	29.381	28.483
Sample Volume, V (cm^3)	224.93	216.74
Wt. Rings + Wet Soil (g)	458.03	478.37
Wt. Rings (g)	0	0
Wet Unit Wt., γ_m (pcf)	127.1	137.8
Wet Soil + Tare (g)	493.57	605.61
Dry Soil + Tare (g)	456.61	539.50
Tare (g)	124.11	127.6
Weight of solids, Ws (g)	412.21	412.21
Water Content, w (%)	11.12	16.05
Dry Unit Wt, γ_d (pcf)	114.4	118.7
Void ratio, e, for assumed Gs	0.45	0.43
Saturation (%), for assumed Gs	66.0	100 [a]
Average K[b] (cm/sec)	**1.9E-04**	

[a] Saturation set to 100% for phase calculations
[b] K corrected to 20°C

Optimum water content (%)	11.5	
Maximum dry unit weight (pcf)	120.2	
Gs	2.65	Assumed
Cell No.	T2	
Station No.	T2	
Permeant liquid used	De-aired tap water	
Total backpressure (psi)	30	
Effective horiz. consolidation stress (psi)	34.7	
Effective vert. consolidation stress (psi)	34.7	

	Initial (o)	Final (f)
B value	0.66	0.98
External Burette (cm^3)	10.10	25.30
Cell Pressure (psi)	0.0	64.7

Backpressure bottom (psi)	30.0
Backpressure top (psi)	30.0
System volume coefficient (cm^3/psi)	0.108
System volume change (cm^3)	7.01
Net sample volume change (cm^3)	-8.19
Bottom burette ground length, l_b (cm)	69.95
Top burette ground length, l_t (cm)	69
Burette area, a (cm^2)	0.873
Conversion, reading to cm head (cm/rd)	1.145

Start Date and Time: 9/23/13 8:42

Elapsed time (sec)	Bottom Burette (cm^3)	Top Burette (cm^3)	h_1 (cm)	h_2 (cm)	K (cm/sec)	Temp (°C)	Visc. Ratio R_t	K[b] (cm/sec)
1380.0	1.00 11.50	24.00 13.50	27.29	3.24	1.8E-04	20.6	0.99	1.8E-04
1200.0	1.00 11.20	24.00 13.80	27.29	3.93	1.9E-04	20.6	0.99	1.9E-04
1260.0	2.40 12.40	24.10 14.10	25.80	2.90	2.0E-04	20.6	0.99	2.0E-04
1200.0	0.90 11.60	24.30 13.50	27.74	3.13	2.1E-04	22.4	0.94	2.0E-04
960.0	2.30 11.60	24.20 14.70	26.03	4.50	2.1E-04	22.4	0.94	2.0E-04
1200.0	0.90 11.30	24.10 13.70	27.51	3.70	2.0E-04	22.4	0.94	1.8E-04

Entered by:__________
Reviewed:__________

Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter, Method C (ASTM D5084)

IGES

Project: CS Mining - SE Pond
No: 01640-002 (III)
Location: Milford, UT
Date: 9/16/2013
By: MP

Boring No.: TP44
Sample:
Depth: 5.0'

Sample Description: Light brown sand with clay and gravel
Sample Type: Laboratory Compacted
Compaction Specifications: 95 (%) Dry unit weight at 12.5 (%) w

	Initial (o)	Final (f)
Sample Height, H (in)	3.018	3.010
Sample Diameter, D (in)	2.407	2.39
Sample Length, L (cm)	7.666	7.646
Sample Area, A (cm^2)	29.357	28.967
Sample Volume, V (cm^3)	225.04	221.47
Wt. Rings + Wet Soil (g)	465.5	Multi-staged
Wt. Rings (g)	0	
Wet Unit Wt., γ_m (pcf)	129.1	
Wet Soil + Tare (g)	591.34	
Dry Soil + Tare (g)	541.06	
Tare (g)	127.72	
Weight of solids, Ws (g)	415.02	
Water Content, w (%)	12.16	
Dry Unit Wt, γ_d (pcf)	115.1	
Void ratio, e, for assumed Gs	0.44	
Saturation (%), for assumed Gs	73.8	
Average K[b] (cm/sec)	**6.3E-04**	

[a] Saturation set to 100% for phase calculations
[b] K corrected to 20°C

Optimum water content (%)	12.5	
Maximum dry unit weight (pcf)	120.9	
Gs	2.65	Assumed
Cell No.	T1	
Station No.	T1	
Permeant liquid used	De-aired tap water	
Total backpressure (psi)	30	
Effective horiz. consolidation stress (psi)	13.9	
Effective vert. consolidation stress (psi)	13.9	

	Initial (o)	Final (f)
B value	0.26	0.96
External Burette (cm^3)	9.50	18.30
Cell Pressure (psi)	0.0	43.9

Backpressure bottom (psi)	30.0
Backpressure top (psi)	30.0
System volume coefficient (cm^3/psi)	0.119
System volume change (cm^3)	5.23
Net sample volume change (cm^3)	-3.57
Bottom burette ground length, l_b (cm)	69.50
Top burette ground length, l_t (cm)	69.5
Burette area, a (cm^2)	0.876
Conversion, reading to cm head (cm/rd)	1.142

Start Date and Time: 9/16/13 12:45

Elapsed time (sec)	Bottom Burette (cm^3)	Top Burette (cm^3)	h_1 (cm)	h_2 (cm)	K (cm/sec)	Temp (°C)	Visc. Ratio R_f	K[b] (cm/sec)
240.0	0.50 9.20	23.00 14.40	25.69	5.94	7.1E-04	24.3	0.90	6.4E-04
300.0	1.80 10.90	23.30 14.30	24.55	3.88	7.1E-04	24.3	0.90	6.4E-04
300.0	3.40 12.00	24.60 15.30	24.20	3.77	7.2E-04	24.7	0.89	6.4E-04
360.0	4.90 13.30	23.70 15.40	21.46	2.40	7.0E-04	24.7	0.89	6.3E-04
360.0	0.50 11.00	24.00 13.60	26.83	2.97	7.1E-04	25.1	0.89	6.3E-04

Entered by:__________
Reviewed:__________

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Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter, Method C (ASTM D5084)

IGES

Project: CS Mining - SE Pond
No: 01640-002 (III)
Location: Milford, UT
Date: 9/17/2013
By: MP

Boring No.: TP44
Sample:
Depth: 5.0'
Sample Description: Light brown sand with clay and gravel
Sample Type: Laboratory Compacted
Compaction Specifications: 95 (%) Dry unit weight at 12.5 (%) w

	Initial (o)	Final (f)
Sample Height, H (in)	3.018	3.007
Sample Diameter, D (in)	2.407	2.38
Sample Length, L (cm)	7.666	7.637
Sample Area, A (cm^2)	29.357	28.798
Sample Volume, V (cm^3)	225.04	219.92
Wt. Rings + Wet Soil (g)	465.5	Multi-staged
Wt. Rings (g)	0	
Wet Unit Wt., γ_m (pcf)	129.1	
Wet Soil + Tare (g)	591.34	
Dry Soil + Tare (g)	541.06	
Tare (g)	127.72	
Weight of solids, Ws (g)	415.02	
Water Content, w (%)	12.16	
Dry Unit Wt, γ_d (pcf)	115.1	
Void ratio, e, for assumed Gs	0.44	
Saturation (%), for assumed Gs	73.8	
Average K[b] (cm/sec)	**5.9E-04**	

[a] Saturation set to 100% for phase calculations
[b] K corrected to 20°C

Optimum water content (%)	12.5	
Maximum dry unit weight (pcf)	120.9	
Gs	2.65	Assumed
Cell No.	T1	
Station No.	T1	
Permeant liquid used	De-aired tap water	
Total backpressure (psi)	30	
Effective horiz. consolidation stress (psi)	27.8	
Effective vert. consolidation stress (psi)	27.8	
	Initial (o)	Final (f)
B value	0.26	0.96
External Burette (cm^3)	9.50	21.50
Cell Pressure (psi)	0.0	57.8
Backpressure bottom (psi)	30.0	
Backpressure top (psi)	30.0	
System volume coefficient (cm^3/psi)	0.119	
System volume change (cm^3)	6.88	
Net sample volume change (cm^3)	-5.12	
Bottom burette ground length, l_b (cm)	69.50	
Top burette ground length, l_t (cm)	69.5	
Burette area, a (cm^2)	0.876	
Conversion, reading to cm head (cm/rd)	1.142	

Start Date and Time: 9/17/13 12:55

Elapsed time (sec)	Bottom Burette (cm^3)	Top Burette (cm^3)	h_1 (cm)	h_2 (cm)	K (cm/sec)	Temp (°C)	Visc. Ratic R_f	K[b] (cm/sec)
300.0	2.00 11.00	23.80 14.80	24.89	4.34	6.8E-04	25.5	0.88	5.9E-04
360.0	3.70 12.20	23.20 14.70	22.26	2.85	6.6E-04	25.5	0.88	5.8E-04
360.0	5.00 13.40	24.10 15.70	21.81	2.63	6.8E-04	25.5	0.88	6.0E-04
360.0	1.80 11.70	24.30 14.40	25.69	3.08	6.8E-04	25.9	0.87	6.0E-04
360.0	3.70 12.60	23.90 15.00	23.06	2.74	6.9E-04	25.9	0.87	6.0E-04

Entered by:__________
Reviewed:__________

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Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter, Method C (ASTM D5084)

IGES

Project: CS Mining - SE Pond
No: 01640-002 (III)
Location: Milford, UT
Date: 9/17/2013
By: MP

Boring No.: TP44
Sample:
Depth: 5.0'

Sample Description: Light brown sand with clay and gravel
Sample Type: Laboratory Compacted
Compaction Specifications: 95 (%) Dry unit weight at 12.5 (%) w

	Initial (o)	Final (f)
Sample Height, H (in)	3.018	3.000
Sample Diameter, D (in)	2.407	2.37
Sample Length, L (cm)	7.666	7.619
Sample Area, A (cm^2)	29.357	28.458
Sample Volume, V (cm^3)	225.04	216.84
Wt. Rings + Wet Soil (g)	465.5	474.92
Wt. Rings (g)	0	0
Wet Unit Wt., γ_m (pcf)	129.1	136.7
Wet Soil + Tare (g)	591.34	605.63
Dry Soil + Tare (g)	541.06	544.98
Tare (g)	127.72	124.77
Weight of solids, Ws (g)	415.02	415.02
Water Content, w (%)	12.16	14.43
Dry Unit Wt, γ_d (pcf)	115.1	119.5
Void ratio, e, for assumed Gs	0.44	0.38
Saturation (%), for assumed Gs	73.8	100 [a]
Average K[b] (cm/sec)	**5.7E-04**	

[a] Saturation set to 100% for phase calculations
[b] K corrected to 20°C

Optimum water content (%)	12.5	
Maximum dry unit weight (pcf)	120.9	
Gs	2.65	Assumed
Cell No.	T1	
Station No.	T1	
Permeant liquid used	De-aired tap water	
Total backpressure (psi)	30	
Effective horiz. consolidation stress (psi)	55.6	
Effective vert. consolidation stress (psi)	55.6	

	Initial (o)	Final (f)
B value	0.26	0.96
External Burette (cm^3)	9.50	27.90
Cell Pressure (psi)	0.0	85.6

Backpressure bottom (psi)	30.0
Backpressure top (psi)	30.0
System volume coefficient (cm^3/psi)	0.119
System volume change (cm^3)	10.19
Net sample volume change (cm^3)	-8.21
Bottom burette ground length, l_b (cm)	69.50
Top burette ground length, l_t (cm)	69.5
Burette area, a (cm^2)	0.876
Conversion, reading to cm head (cm/rd)	1.142

Start Date and Time: 9/17/13 12:55

Elapsed time (sec)	Bottom Burette (cm^3)	Top Burette (cm^3)	h_1 (cm)	h_2 (cm)	K (cm/sec)	Temp (°C)	Visc. Ratio R_f	K[b] (cm/sec)
360.0	0.40 10.30	23.70 13.90	26.60	4.11	6.1E-04	22.5	0.94	5.7E-04
360.0	1.50 10.60	23.60 14.00	25.23	3.88	6.1E-04	22.5	0.94	5.7E-04
360.0	3.30 11.90	23.70 15.00	23.29	3.54	6.1E-04	22.5	0.94	5.8E-04
360.0	0.50 10.30	23.70 14.00	26.49	4.22	6.0E-04	22.6	0.94	5.6E-04

Entered by:__________
Reviewed:__________

Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter, Method C (ASTM D5084)

IGES

Project: CS Mining - SE Pond
No: 01640-002 (III)
Location: Milford, UT
Date: 9/17/2013
By: MP

Boring No.: TP51
Sample:
Depth: 4-5'
Sample Description: Brown sand with silt and gravel
Sample Type: Laboratory Compacted
Compaction Specifications: 95 (%) Dry unit weight at 12.4 (%) w

	Initial (o)	Final (f)
Sample Height, H (in)	3.079	3.081
Sample Diameter, D (in)	2.38	2.38
Sample Length, L (cm)	7.821	7.825
Sample Area, A (cm^2)	28.702	28.787
Sample Volume, V (cm^3)	224.47	225.26
Wt. Rings + Wet Soil (g)	450.06	Multi-staged
Wt. Rings (g)	0	
Wet Unit Wt., γ_m (pcf)	125.2	
Wet Soil + Tare (g)	477.56	
Dry Soil + Tare (g)	440.26	
Tare (g)	140.31	
Weight of solids, Ws (g)	400.28	
Water Content, w (%)	12.44	
Dry Unit Wt, γ_d (pcf)	111.3	
Void ratio, e, for assumed Gs	0.49	
Saturation (%), for assumed Gs	67.8	
Average K[b] (cm/sec)	**7.92E-04**	

[a] Saturation set to 100% for phase calculations
[b] K corrected to 20°C

Optimum water content (%)	12.4	
Maximum dry unit weight (pcf)	116.6	
Gs	2.65	Assumed
Cell No.	T1	
Station No.	T1	
Permeant liquid used	De-aired tap water	
Total backpressure (psi)	30	
Effective horiz. consolidation stress (psi)	6.9	
Effective vert. consolidation stress (psi)	6.9	

	Initial (o)	Final (f)
B value	0.68	0.96
External Burette (cm^3)	10.50	14.10
Cell Pressure (psi)	0.0	36.9

Backpressure bottom (psi)	30.0
Backpressure top (psi)	30.0
System volume coefficient (cm^3/psi)	0.119
System volume change (cm^3)	4.39
Net sample volume change (cm^3)	0.79
Bottom burette ground length, l_b (cm)	69.50
Top burette ground length, l_t (cm)	69.5
Burette area, a (cm^2)	0.876
Conversion, reading to cm head (cm/rd)	1.142

Start Date and Time: 9/21/13 12:13

Elapsed time (sec)	Bottom Burette (cm^3)	Top Burette (cm^3)	h_1 (cm)	h_2 (cm)	K (cm/sec)	Temp (°C)	Visc. Ratio R_f	K[b] (cm/sec)
300.0	1.00 11.00	24.00 14.00	26.26	3.43	8.1E-04	22.0	0.95	7.7E-04
240.0	1.00 10.30	24.00 14.70	26.26	5.02	8.2E-04	21.2	0.97	8.0E-04
240.0	1.00 10.40	24.00 14.80	26.26	5.02	8.2E-04	21.2	0.97	8.0E-04
240.0	1.00 10.40	24.00 14.70	26.26	4.91	8.3E-04	21.4	0.97	8.0E-04

Entered by:__________
Reviewed:__________

Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter, Method C (ASTM D5084)

IGES

Project: CS Mining - SE Pond
No: 01640-002 (III)
Location: Milford, UT
Date: 9/17/2013
By: MP

Boring No.: TP51
Sample:
Depth: 4-5'
Sample Description: Brown sand with silt and gravel
Sample Type: Laboratory Compacted
Compaction Specifications: 95 (%) Dry unit weight at 12.4 (%) w

	Initial (o)	Final (f)
Sample Height, H (in)	3.079	3.074
Sample Diameter, D (in)	2.38	2.37
Sample Length, L (cm)	7.821	7.807
Sample Area, A (cm^2)	28.702	28.450
Sample Volume, V (cm^3)	224.47	222.12
Wt. Rings + Wet Soil (g)	450.06	
Wt. Rings (g)	0	
Wet Unit Wt., γ_m (pcf)	125.2	
Wet Soil + Tare (g)	477.56	Multi-staged
Dry Soil + Tare (g)	440.26	
Tare (g)	140.31	
Weight of solids, Ws (g)	400.28	
Water Content, w (%)	12.44	
Dry Unit Wt, γ_d (pcf)	111.3	
Void ratio, e, for assumed Gs	0.49	
Saturation (%), for assumed Gs	67.8	
Average K[b] (cm/sec)	**7.03E-04**	

[a] Saturation set to 100% for phase calculations
[b] K corrected to 20°C

Optimum water content (%)	12.4	
Maximum dry unit weight (pcf)	116.6	
Gs	2.65	Assumed
Cell No.	T1	
Station No.	T1	
Permeant liquid used	De-aired tap water	
Total backpressure (psi)	30	
Effective horiz. consolidation stress (psi)	20.8	
Effective vert. consolidation stress (psi)	20.8	

	Initial (o)	Final (f)
B value	0.68	0.96
External Burette (cm^3)	10.50	18.90
Cell Pressure (psi)	0.0	50.8

Backpressure bottom (psi)	30.0
Backpressure top (psi)	30.0
System volume coefficient (cm^3/psi)	0.119
System volume change (cm^3)	6.05
Net sample volume change (cm^3)	-2.35
Bottom burette ground length, l_b (cm)	69.50
Top burette ground length, l_t (cm)	69.5
Burette area, a (cm^2)	0.876
Conversion, reading to cm head (cm/rd)	1.142

Start Date and Time: 9/23/13 9:30

Elapsed time (sec)	Bottom Burette (cm^3)	Top Burette (cm^3)	h_1 (cm)	h_2 (cm)	K (cm/sec)	Temp (°C)	Visc. Ratic R_f	K[b] (cm/sec)
360.0	1.00 11.20	24.00 13.80	26.26	2.97	7.3E-04	20.6	0.99	7.17E-04
360.0	1.00 11.20	24.00 13.80	26.26	2.97	7.3E-04	20.6	0.99	7.17E-04
360.0	1.00 11.10	24.00 13.90	26.26	3.20	7.0E-04	20.6	0.99	6.93E-04
360.0	1.00 11.10	24.00 13.90	26.26	3.20	7.0E-04	20.6	0.99	6.93E-04
480.0	1.00 11.80	24.00 13.20	26.26	1.60	7.0E-04	20.7	0.98	6.89E-04
360.0	2.20 11.60	24.00 14.10	24.89	2.85	7.2E-04	20.7	0.98	7.11E-04

Entered by:___________
Reviewed:___________

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Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter, Method C (ASTM D5084)

IGES

Project: CS Mining - SE Pond
No: 01640-002 (III)
Location: Milford, UT
Date: 9/17/2013
By: MP

Boring No.: TP51
Sample:
Depth: 4-5'
Sample Description: Brown sand with silt and gravel
Sample Type: Laboratory Compacted
Compaction Specifications: 95 (%) Dry unit weight at 12.4 (%) w

	Initial (o)	Final (f)
Sample Height, H (in)	3.079	3.070
Sample Diameter, D (in)	2.38	2.36
Sample Length, L (cm)	7.821	7.797
Sample Area, A (cm^2)	28.702	28.262
Sample Volume, V (cm^3)	224.47	220.37
Wt. Rings + Wet Soil (g)	450.06	468.98
Wt. Rings (g)	0	0
Wet Unit Wt., γ_m (pcf)	125.2	132.9
Wet Soil + Tare (g)	477.56	547.11
Dry Soil + Tare (g)	440.26	485.7
Tare (g)	140.31	127.9
Weight of solids, Ws (g)	400.28	400.28
Water Content, w (%)	12.44	17.16
Dry Unit Wt, γ_d (pcf)	111.3	113.4
Void ratio, e, for assumed Gs	0.49	0.46
Saturation (%), for assumed Gs	67.8	99.1
Average K[b] (cm/sec)	**6.84E-04**	

[a] Saturation set to 100% for phase calculations
[b] K corrected to 20°C

Optimum water content (%)	12.4	
Maximum dry unit weight (pcf)	116.6	
Gs	2.65	Assumed
Cell No.	T1	
Station No.	T1	
Permeant liquid used	De-aired tap water	
Total backpressure (psi)	30	
Effective horiz. consolidation stress (psi)	34.7	
Effective vert. consolidation stress (psi)	34.7	

	Initial (o)	Final (f)
B value	0.68	0.96
External Burette (cm^3)	10.50	22.30
Cell Pressure (psi)	0.0	64.7

Backpressure bottom (psi)	30.0
Backpressure top (psi)	30.0
System volume coefficient (cm^3/psi)	0.119
System volume change (cm^3)	7.70
Net sample volume change (cm^3)	-4.10
Bottom burette ground length, l_b (cm)	69.50
Top burette ground length, l_t (cm)	69.5
Burette area, a (cm^2)	0.876
Conversion, reading to cm head (cm/rd)	1.142

Start Date and Time: 9/24/13 8:50

Elapsed time (sec)	Bottom Burette (cm^3)	Top Burette (cm^3)	h_1 (cm)	h_2 (cm)	K (cm/sec)	Temp (°C)	Visc. Ratio R_t	K[b] (cm/sec)
360.0	0.40 10.60	23.70 13.50	26.60	3.31	7.0E-04	20.5	0.99	6.9E-04
360.0	0.50 10.50	23.40 13.40	26.14	3.31	6.9E-04	21.0	0.98	6.8E-04
360.0	1.80 11.40	23.60 14.00	24.89	2.97	7.1E-04	21.1	0.97	6.9E-04
360.0	0.50 10.60	23.60 13.50	26.37	3.31	7.0E-04	21.1	0.97	6.8E-04
360.0	0.00 10.50	24.00 13.50	27.40	3.43	7.0E-04	21.1	0.97	6.8E-04

Entered by:__________
Reviewed:__________

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Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter, Method C (ASTM D5084)

IGES

Project: CS Mining - SE Pond
No: 01640-002 (III)
Location: Milford, UT
Date: 9/17/2013
By: MP

Boring No.: TP52
Sample:
Depth: 4-5'
Sample Description: Light brown sand with silt and gravel
Sample Type: Laboratory Compacted
Compaction Specifications: 95 (%) Dry unit weight at 11 (%) w

	Initial (o)	Final (f)
Sample Height, H (in)	3.027	3.020
Sample Diameter, D (in)	2.402	2.39
Sample Length, L (cm)	7.689	7.670
Sample Area, A (cm^2)	29.235	28.883
Sample Volume, V (cm^3)	224.78	221.55
Wt. Rings + Wet Soil (g)	451.5	
Wt. Rings (g)	0	
Wet Unit Wt., γ_m (pcf)	125.4	Multi-staged
Wet Soil + Tare (g)	746.88	
Dry Soil + Tare (g)	690.53	
Tare (g)	160.19	
Weight of solids, Ws (g)	408.13	
Water Content, w (%)	10.63	
Dry Unit Wt, γ_d (pcf)	113.4	
Void ratio, e, for assumed Gs	0.46	
Saturation (%), for assumed Gs	61.3	
Average K[b] (cm/sec)	**6.89E-04**	

[a] Saturation set to 100% for phase calculations
[b] K corrected to 20°C

Optimum water content (%)	11	
Maximum dry unit weight (pcf)	118.9	
Gs	2.65	Assumed
Cell No.	T3	
Station No.	4	
Permeant liquid used	De-aired tap water	
Total backpressure (psi)	29.5	
Effective horiz. consolidation stress (psi)	13.9	
Effective vert. consolidation stress (psi)	13.9	

	Initial (o)	Final (f)
B value	0.18	0.96
External Burette (cm^3)	20.20	28.00
Cell Pressure (psi)	0.0	43.4

Backpressure bottom (psi)	29.5
Backpressure top (psi)	29.5
System volume coefficient (cm^3/psi)	0.105
System volume change (cm^3)	4.57
Net sample volume change (cm^3)	-3.23
Bottom burette ground length, l_b (cm)	81.90
Top burette ground length, l_t (cm)	81.98
Burette area, a (cm^2)	0.197
Conversion, reading to cm head (cm/rd)	5.076

Start Date and Time: 9/17/13 10:28

Elapsed time (sec)	Bottom Burette (cm^3)	Top Burette (cm^3)	h_1 (cm)	h_2 (cm)	K (cm/sec)	Temp (°C)	Visc. Ratio R_f	K[b] (cm/sec)
45.0	0.00 3.58	10.00 6.40	50.68	14.23	7.4E-04	23.4	0.92	6.8E-04
45.0	0.00 3.62	10.00 6.34	50.68	13.73	7.6E-04	23.4	0.92	7.0E-04
60.0	0.00 4.10	10.00 5.92	50.68	9.16	7.5E-04	23.4	0.92	6.9E-04
60.0	0.00 4.10	10.00 5.90	50.68	9.06	7.5E-04	23.4	0.92	6.9E-04
50.0	0.00 3.82	10.00 6.22	50.68	12.10	7.5E-04	23.6	0.92	6.9E-04

Entered by:__________
Reviewed:__________

Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter, Method C (ASTM D5084)

IGES

Project: CS Mining - SE Pond
No: 01640-002 (III)
Location: Milford, UT
Date: 9/17/2013
By: MP

Boring No.: TP52
Sample:
Depth: 4-5'

Sample Description: Light brown sand with silt and gravel
Sample Type: Laboratory Compacted
Compaction Specifications: 95 (%) Dry unit weight at 11 (%) w

	Initial (o)	Final (f)
Sample Height, H (in)	3.027	3.016
Sample Diameter, D (in)	2.402	2.38
Sample Length, L (cm)	7.689	7.659
Sample Area, A (cm^2)	29.235	28.672
Sample Volume, V (cm^3)	224.78	219.61
Wt. Rings + Wet Soil (g)	451.5	
Wt. Rings (g)	0	
Wet Unit Wt., γ_m (pcf)	125.4	
Wet Soil + Tare (g)	746.88	Multi-staged
Dry Soil + Tare (g)	690.53	
Tare (g)	160.19	
Weight of solids, Ws (g)	408.13	
Water Content, w (%)	10.63	
Dry Unit Wt, γ_d (pcf)	113.4	
Void ratio, e, for assumed Gs	0.46	
Saturation (%), for assumed Gs	61.3	
Average K[b] (cm/sec)	**6.87E-04**	

[a] Saturation set to 100% for phase calculations
[b] K corrected to 20°C

Optimum water content (%)	11	
Maximum dry unit weight (pcf)	118.9	
Gs	2.65	Assumed
Cell No.	T3	
Station No.	4	
Permeant liquid used	De-aired tap water	
Total backpressure (psi)	29.5	
Effective horiz. consolidation stress (psi)	27.8	
Effective vert. consolidation stress (psi)	27.8	

	Initial (o)	Final (f)
B value	0.18	0.96
External Burette (cm^3)	20.20	31.40
Cell Pressure (psi)	0.0	57.3

Backpressure bottom (psi)	29.5
Backpressure top (psi)	29.5
System volume coefficient (cm^3/psi)	0.105
System volume change (cm^3)	6.03
Net sample volume change (cm^3)	-5.17
Bottom burette ground length, l_b (cm)	81.90
Top burette ground length, l_t (cm)	81.98
Burette area, a (cm^2)	0.197
Conversion, reading to cm head (cm/rd)	5.076

Start Date and Time: 9/18/13 10:54

Elapsed time (sec)	Bottom Burette (cm^3)	Top Burette (cm^3)	h_1 (cm)	h_2 (cm)	K (cm/sec)	Temp (°C)	Visc. Ratio R_f	K[b] (cm/sec)
45.0	0.00 3.52	10.00 6.46	50.68	14.84	7.2E-04	21.5	0.96	6.92E-04
60.0	0.00 4.02	10.00 5.98	50.68	9.87	7.2E-04	21.5	0.96	6.92E-04
60.0	0.00 4.02	10.00 6.00	50.68	9.97	7.1E-04	21.5	0.96	6.87E-04
75.0	0.00 4.34	10.00 5.64	50.68	6.52	7.2E-04	21.5	0.96	6.94E-04
75.0	0.00 4.34	10.00 5.66	50.68	6.62	7.1E-04	21.6	0.96	6.86E-04
80.0	0.00 4.40	10.00 5.60	50.68	6.01	7.0E-04	21.2	0.97	6.81E-04
50.0	0.00 3.68	10.00 6.32	50.68	13.32	7.0E-04	21.4	0.97	6.79E-04

Entered by:___________
Reviewed:___________

Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter, Method C (ASTM D5084)

Project: CS Mining - SE Pond
No: 01640-002 (III)
Location: Milford, UT
Date: 9/17/2013
By: MP

Boring No.: TP52
Sample:
Depth: 4-5'

Sample Description: Light brown sand with silt and gravel
Sample Type: Laboratory Compacted
Compaction Specifications: 95 (%) Dry unit weight at 11 (%) w

	Initial (o)	Final (f)
Sample Height, H (in)	3.027	3.013
Sample Diameter, D (in)	2.402	2.37
Sample Length, L (cm)	7.689	7.654
Sample Area, A (cm^2)	29.235	28.569
Sample Volume, V (cm^3)	224.78	218.67
Wt. Rings + Wet Soil (g)	451.5	470.93
Wt. Rings (g)	0	0
Wet Unit Wt., γ_m (pcf)	125.4	134.4
Wet Soil + Tare (g)	746.88	597.99
Dry Soil + Tare (g)	690.53	534.26
Tare (g)	160.19	120.08
Weight of solids, Ws (g)	408.13	408.13
Water Content, w (%)	10.63	15.39
Dry Unit Wt, γ_d (pcf)	113.4	116.5
Void ratio, e, for assumed Gs	0.46	0.42
Saturation (%), for assumed Gs	61.3	97.1
Average K[b] (cm/sec)	**6.84E-04**	

[a] Saturation set to 100% for phase calculations
[b] K corrected to 20°C

Optimum water content (%)	11	
Maximum dry unit weight (pcf)	118.9	
Gs	2.65	Assumed
Cell No.	T3	
Station No.	4	
Permeant liquid used	De-aired tap water	
Total backpressure (psi)	29.5	
Effective horiz. consolidation stress (psi)	41.7	
Effective vert. consolidation stress (psi)	41.7	

	Initial (o)	Final (f)
B value	0.18	0.96
External Burette (cm^3)	20.20	33.80
Cell Pressure (psi)	0.0	71.2

Backpressure bottom (psi)	29.5
Backpressure top (psi)	29.5
System volume coefficient (cm^3/psi)	0.105
System volume change (cm^3)	7.50
Net sample volume change (cm^3)	-6.10
Bottom burette ground length, l_b (cm)	81.90
Top burette ground length, l_t (cm)	81.98
Burette area, a (cm^2)	0.197
Conversion, reading to cm head (cm/rd)	5.076

Start Date and Time: 9/20/13 14:35

Elapsed time (sec)	Bottom Burette (cm^3)	Top Burette (cm^3)	h_1 (cm)	h_2 (cm)	K (cm/sec)	Temp (°C)	Visc. Ratio R_t	K[b] (cm/sec)
60.0	0.18 4.04	10.00 6.12	49.77	10.48	6.9E-04	19.9	1.00	6.9E-04
60.0	0.00 3.96	10.00 6.06	50.68	10.58	6.9E-04	20.2	1.00	6.9E-04
45.0	0.00 3.42	10.00 6.58	50.68	15.96	6.8E-04	19.4	1.02	6.9E-04
45.0	0.00 3.44	10.00 6.56	50.68	15.76	6.9E-04	19.4	1.02	7.0E-04
60.0	0.00 3.94	10.00 6.08	50.68	10.78	6.8E-04	20.8	0.98	6.7E-04

Entered by:___________
Reviewed:___________

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Identification and Classification of Dispersive Clay Soils by the Pinhole Test

(ASTM D 4647 Method A)

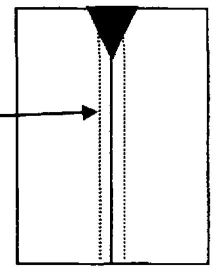
Project: CS Mining - SE Pond
No: 01640-002 (III)
Location: Milford, UT
Date: 9/16/13
By: BRR

Boring No.: TP41
Sample:
Depth: 4-6'
Test Specification: 95% ASTM D698 B @ optimum water content
Visual Description: Light brown clayey sand

Type of test: Method A
Sample type: Remolded
Water content (%): 16.5
Dry unit weight (pcf): 102.5

Engineering Classification Not requested

Specimen After Test
Final Hole (mm): 0.0



Dispersive Classification: ND1 - Nondisperisve

Clock Time	Head (in)	Flow: ml	Flow: sec	Flow: Rate (ml/sec)	Turbidity From Side: Very Dark	Dark	Moderately Dark	Slightly Dark	Barely Visible	Completely Clear	Completely Clear From Top	Particles Falling: None	Few	Heavy	Remarks
0:00	2	18.0	60	0.3					X			X			
	2	21.0	60	0.4					X			X			
0:05	2	21.0	60	0.4					X			X			
	2	22.0	60	0.4					X			X			
0:10	7	49.0	60	0.8					X			X			
	7	48.0	60	0.8					X			X			
	7	49.0	60	0.8					X			X			
0:15	15	76.0	60	1.3				X					X		
	15	81.0	60	1.4					X				X		
	15	41.0	30	1.4				X					X		
0:20	40	64.0	30	2.1				X					X		
	40	66.0	30	2.2					X				X		
0:25	40	43.0	30	1.4					X				X		

Comments: There was not a pinhole in the specimen after testing.

Entered by:___________
Reviewed:___________

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Identification and Classification of Dispersive Clay Soils by the Pinhole Test

(ASTM D 4647 Method A)

IGES

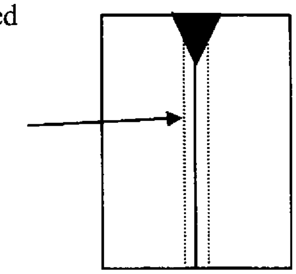
Project: CS Mining - SE Pond
No: 01640-002 (III)
Location: Milford, UT
Date: 9/16/13
By: BRR

Boring No.: TP42
Sample:
Depth: 5-6'
Test Specification: 95% ASTM D698 B @ optimum water content
Visual Description: Light brown sand with silt

Type of test: Method A
Sample type: Remolded
Water content (%): 14
Dry unit weight (pcf): 111.8

Engineering Classification Not requested

Specimen After Test
Final Hole (mm): >2.0



Dispersive Classification: ND3 - Moderately to Slightly Dispersive

		Flow			Turbidity From Side							Particles Falling			
Clock Time	Head (in)	ml	sec	Rate (ml/sec)	Very Dark	Dark	Moderately Dark	Slightly Dark	Barely Visible	Completely Clear	Completely Clear From Top	None	Few	Heavy	Remarks
0:00	2	18.0	60	0.3			X						X		
	2	11.0	60	0.2				X					X		
	2	5.4	60	0.1				X					X		
0:05	2	4.8	60	0.1				X					X		
	2	2.8	60	0.05					X			X			
0:10	7	4.7	60	0.1				X					X		
	7	1.0	60	0.02			X						X		
0:15	15	4.3	60	0.1		X								X	
	15	4.0	60	0.1		X								X	
0:20	40	8.2	30	0.3	X									X	

Entered by:__________

Reviewed:__________

Identification and Classification of Dispersive Clay Soils by the Pinhole Test

(ASTM D 4647 Method A)

IGES

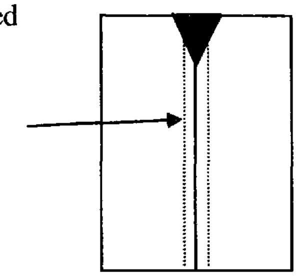
Project: CS Mining - SE Pond
No: 01640-002 (III)
Location: Milford, UT
Date: 9/16/13
By: BRR

Boring No.: TP43
Sample:
Depth: 6-8'
Test Specification: 95% ASTM D698 B @ optimum water content
Visual Description: Light brown silty sand with gravel

Type of test: Method A
Sample type: Remolded
Water content (%): 11.5
Dry unit weight (pcf): 114.2

Engineering Classification Not requested

Specimen After Test
Final Hole (mm): 0.0



Dispersive Classification: ND1 - Nondisperisve

Clock Time	Head (in)	Flow			Turbidity From Side						Completely Clear From Top	Particles Falling			Remarks
		ml	sec	Rate (ml/sec)	Very Dark	Dark	Moderately Dark	Slightly Dark	Barely Visible	Completely Clear		None	Few	Heavy	
0:00	2	21.0	60	0.4				X					X		
	2	29.0	60	0.5				X					X		
0:05	2	29.0	60	0.5				X					X		
	2	28.0	60	0.5					X			X			
0:10	7	64.0	60	1.1				X					X		
	7	64.0	60	1.1				X					X		
0:15	15	59.0	60	1.0					X			X			
	15	58.0	60	1.0					X			X			
0:20	40	83.0	60	1.4			X							X	

Comments: There was not a pinhole in the specimen after testing.

Entered by:__________

Reviewed:__________

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Identification and Classification of Dispersive Clay Soils by the Pinhole Test

(ASTM D 4647 Method A)

IGES

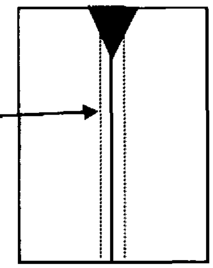
Project: CS Mining - SE Pond
No: 01640-002 (III)
Location: Milford, UT
Date: 9/16/13
By: BRR

Boring No.: TP44
Sample:
Depth: 5.0'
Test Specification: 95% ASTM D698 B @ optimum water content
Visual Description: Light brown sand with clay and gravel

Type of test: Method A
Sample type: Remolded
Water content (%): 12.5
Dry unit weight (pcf): 114.9

Engineering Classification Not requested

Specimen After Test
Final Hole (mm): <1.5



Dispersive Classification: ND3 - Moderately to Slightly Dispersive

Clock Time	Head (in)	Flow			Turbidity From Side						Completely Clear From Top	Particles Falling			Remarks
		ml	sec	Rate (ml/sec)	Very Dark	Dark	Moderately Dark	Slightly Dark	Barely Visible	Completely Clear		None	Few	Heavy	
0:00	2	33.0	60	0.6					X			X			
	2	35.0	60	0.6						X	X	X			
0:05	2	34.0	60	0.6						X	X	X			
	2	34.0	60	0.6						X	X	X			
0:10	7	65.0	60	1.1					X				X		
	7	66.0	60	1.1					X				X		
	7	67.0	60	1.1					X			X			
0:15	15	58.0	30	1.9						X		X			
	15	40.0	30	1.3						X		X			
	15	56.0	30	1.9						X		X			
0:20	40	98.0	30	3.3					X				X		
	40	50.0	15	3.3						X	X	X			
0:25	40	48.0	15	3.2						X	X	X			

Entered by:____________
Reviewed:____________

Identification and Classification of Dispersive Clay Soils by the Pinhole Test

(ASTM D 4647 Method A)

IGES

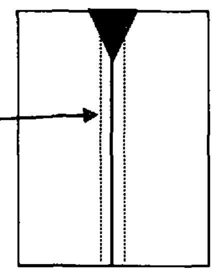
Project: CS Mining - SE Pond
No: 01640-002 (III)
Location: Milford, UT
Date: 9/16/13
By: DKS

Boring No.: TP51
Sample:
Depth: 4-5'
Test Specification: 95% ASTM D698 B @ optimum water content
Visual Description: Brown sand with silt and gravel

Type of test: Method A
Sample type: Remolded
Water content (%): 12.9
Dry unit weight (pcf): 116.6

Engineering Classification Not requested

Specimen After Test
Final Hole (mm): 0.0



Dispersive Classification: ND2 - Nondispersive

Clock Time	Head (in)	Flow: ml	Flow: sec	Flow: Rate (ml/sec)	Turbidity From Side: Very Dark	Turbidity From Side: Dark	Turbidity From Side: Moderately Dark	Turbidity From Side: Slightly Dark	Turbidity From Side: Barely Visible	Turbidity From Side: Completely Clear	Completely Clear From Top	Particles Falling: None	Particles Falling: Few	Particles Falling: Heavy	Remarks
:00	2	6.0	60	0.1			X						X		
	2	5.0	60	0.1				X				X			
0:05	2	2.5	60	0.04				X				X			
	2	2.2	60	0.04				X				X			
0:10	7	13.0	60	0.2		X							X		
	7	7.0	60	0.1			X					X			
0:15	15	16.0	60	0.3				X				X			
	15	11.0	60	0.2					X			X			
0:20	40	5.0	60	0.1			X						X		
	40	4.0	60	0.1				X				X			

Comments: There was not a pinhole in the specimen after testing.

Entered by:__________

Reviewed:__________

Identification and Classification of Dispersive Clay Soils by the Pinhole Test

(ASTM D 4647 Method A)

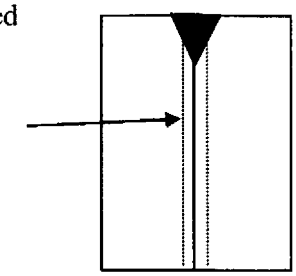
IGES

Project: CS Mining - SE Pond
No: 01640-002 (III)
Location: Milford, UT
Date: 9/16/13
By: DKS/BRR

Boring No.: TP52
Sample:
Depth: 4-5'
Test Specification: 95% ASTM D698 B @ optimum water content
Visual Description: Light brown sand with silt and gravel
Engineering Classification: Not requested

Type of test: Method A
Sample type: Remolded
Water content (%): 11
Dry unit weight (pcf): 113

Specimen After Test
Final Hole (mm): 0.0



Dispersive Classification: ND2 - Nondispersive

Clock Time	Head (in)	Flow: ml	Flow: sec	Flow: Rate (ml/sec)	Turbidity From Side: Very Dark	Dark	Moderately Dark	Slightly Dark	Barely Visible	Completely Clear	Completely Clear From Top	Particles Falling: None	Few	Heavy	Remarks
:00	2	42.0	60	0.7					X			X			
	2	39.0	60	0.7					X			X			
0:05	2	24.0	60	0.4					X			X			
	2	11.0	60	0.2					X			X			
	2	6.0	30	0.2					X			X			
0:10	7	11.0	60	0.2				X				X			
	7	5.0	60	0.1				X				X			
0:15	15	5.0	60	0.1				X				X			
	15	3.0	90	0.0				X				X			
0:20	40	2.6	60	0.0		X							X		
	40	1.9	60	0.0			X						X		

Entered by:___________

Reviewed:___________

Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis

(ASTM D6913)

IGES

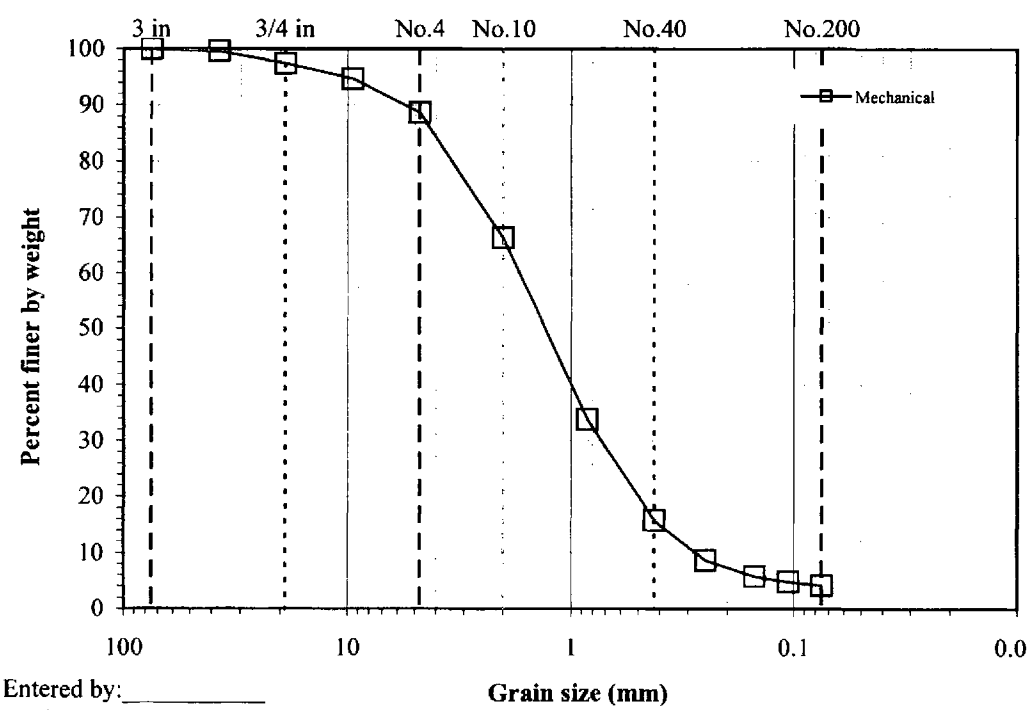
Project: CS Mining SE Facility Development
No: 01640-003
Location: Milford, UT
Date: 3/20/2013
By: BRR

Boring No.: TP-1
Sample:
Depth: 0-3'
Description: Brown sand

Split:	Yes	
Split sieve:	3/8"	
	Moist	Dry
Total sample wt. (g):	27817.53	26636.1
+3/8" Coarse fraction (g):	1470.83	1438.9
-3/8" Split fraction (g):	983.24	940.34
Split fraction:	0.946	

Water content data	C.F.(+3/8")	S.F.(-3/8")
Moist soil + tare (g):	1935.02	1450.23
Dry soil + tare (g):	1903.12	1407.33
Tare (g):	464.19	466.99
Water content (%):	2.2	4.6

Sieve	Accum. Wt. Ret. (g)	Grain Size (mm)	Percent Finer	
8"	-	200	-	
6"	-	150	-	
4"	-	100	-	
3"	-	75	100.0	
1.5"	129.10	37.5	99.5	
3/4"	686.52	19	97.4	
3/8"	1439.83	9.5	94.6	←Split
No.4	59.42	4.75	88.6	
No.10	282.05	2	66.2	
No.20	604.50	0.85	33.8	
No.40	783.70	0.425	15.8	
No.60	854.04	0.25	8.7	
No.100	882.80	0.15	5.8	
No.140	892.83	0.106	4.8	
No.200	898.69	0.075	4.2	



Gravel (%): 11.4
Sand (%): 84.4
Fines (%): 4.2

Entered by:__________
Reviewed:__________

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Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis

(ASTM D6913)

IGES

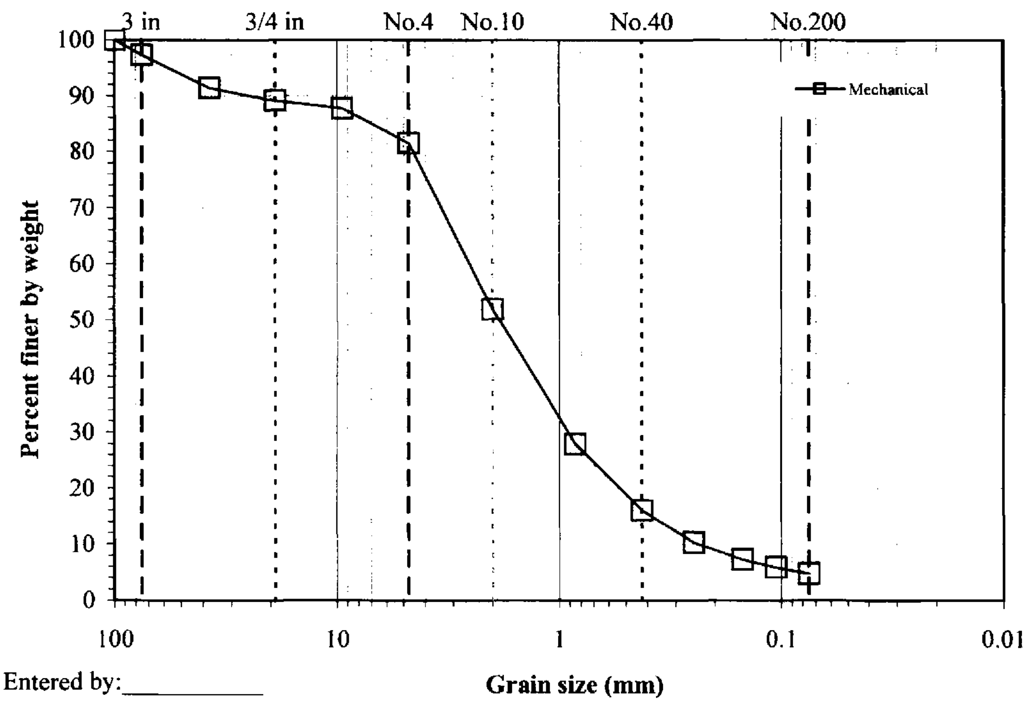
Project: CS Mining SE Facility Development
No: 01640-003
Location: Milford, UT
Date: 3/20/2013
By: BRR

Boring No.: TP-1
Sample:
Depth: 7'
Description: Brown sand with gravel

Split:	Yes	
Split sieve:	3/4"	
	Moist	Dry
Total sample wt. (g):	22078.36	21530.4
+3/4" Coarse fraction (g):	2372.06	2353.3
-3/4" Split fraction (g):	1745.06	1698.20
Split fraction:	0.891	

Water content data	C.F.(+3/4")	S.F.(-3/4")
Moist soil + tare (g):	2835.04	2061.64
Dry soil + tare (g):	2816.28	2014.78
Tare (g):	462.96	316.58
Water content (%):	0.8	2.8

Sieve	Accum. Wt. Ret. (g)	Grain Size (mm)	Percent Finer	
8"	-	200	-	
6"	-	150	-	
4"	-	100	100.0	
3"	584.57	75	97.3	
1.5"	1855.65	37.5	91.4	
3/4"	2353.30	19	89.1	←Split
3/8"	27.17	9.5	87.6	
No.4	145.26	4.75	81.5	
No.10	709.35	2	51.9	
No.20	1167.75	0.85	27.8	
No.40	1391.71	0.425	16.1	
No.60	1500.83	0.25	10.4	
No.100	1558.67	0.15	7.3	
No.140	1585.00	0.106	5.9	
No.200	1605.97	0.075	4.8	



Gravel (%): 18.5
Sand (%): 76.6
Fines (%): 4.8

Entered by:__________
Reviewed:__________

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Laboratory Compaction Characteristics of Soil

(ASTM D698 / D1557)

IGES

Project: CS Mining SE Facility Development
No: 01640-003
Location: Milford, UT
Date: 3/18/2013
By: BRR

Boring No.: TP-1
Sample:
Depth: 0-3'
Sample Description: Brown sand
Engineering Classification: Not requested
As-received water content (%): Not requested

Method: ASTM D698 B
Mold Id. Inc 1
Mold volume (ft^3): 0.0333

Preparation method: Moist
Rammer: Mechanical-circular face
Rock Correction: Yes * See results below
Percent fraction retained, Pc (%) 5.4
Percent fraction passing, Pf (%) 94.6

Optimum water content (%): 8.4
Maximum dry unit weight (pcf): 107.5

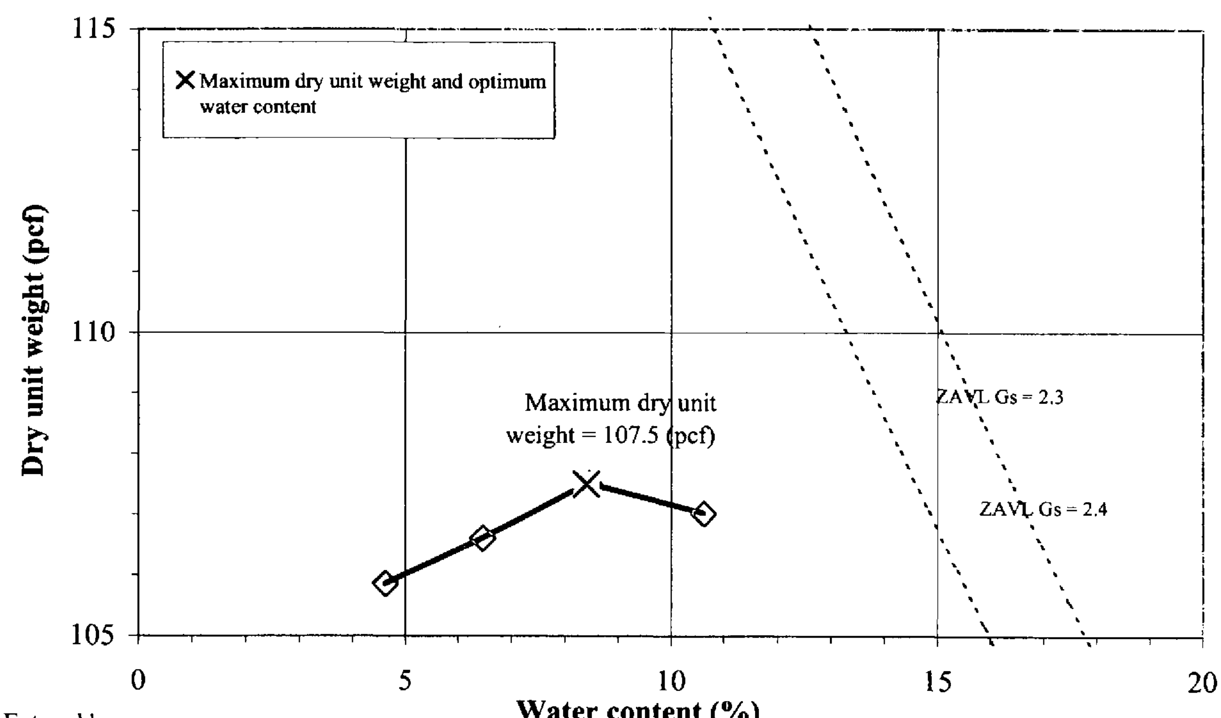
Point Number	As Is	+2%	+4%	+6%				
Wt. Sample + Mold (g)	5920.6	5962.1	6008.7	6035.9				
Wt. of Mold (g)	4248.1	4248.1	4248.1	4248.1				
Wet Unit Wt., γ_m (pcf)	110.7	113.5	116.6	118.4				
Wet Soil + Tare (g)	561.29	668.78	636.07	628.71				
Dry Soil + Tare (g)	542.14	635.66	596.20	580.69				
Tare (g)	127.39	122.64	123.64	128.23				
Water Content, w (%)	**4.6**	**6.5**	**8.4**	**10.6**				
Dry Unit Wt., γ_d (pcf)	**105.9**	**106.6**	**107.5**	**107.0**				

*Correction of Unit Weight and Water Content for Soils Containing Oversize Particles

(ASTM D4718)

Corrected water content (%): 8.1
Corrected dry unit weight (pcf): 109.6

Oversized fraction, +3/8-in. (%): 5.4
Water content, +3/8-in. (%): 2.2
Sieve for oversized fraction: 3/8-in.
Bulk specific gravity, Gs: 2.65 Assumed



Entered by:__________

Reviewed:__________

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Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter, Method C (ASTM D5084)

IGES

Project: CS Mining SE Facility Development
No: 01640-003
Location: Milford, UT
Date: 3/26/2013
By: JDF

Boring No.: TP-1
Sample:
Depth: 0-3'

Sample Description: Brown sand
Sample Type: Laboratory Compacted
Compaction Specifications: 95 (%) Dry unit weight at 10.4 (%) w

	Initial (o)	Final (f)
Sample Height, H (in)	3.000	2.987
Sample Diameter, D (in)	2.4	2.37
Sample Length, L (cm)	7.620	7.588
Sample Area, A (cm^2)	29.186	28.570
Sample Volume, V (cm^3)	222.40	216.79
Wt. Rings + Wet Soil (g)	403.14	433.84
Wt. Rings (g)	0	0
Wet Unit Wt., γ_m (pcf)	113.2	124.9
Wet Soil + Tare (g)	432.85	555.82
Dry Soil + Tare (g)	403.9	488.41
Tare (g)	123.07	128.08
Weight of solids, Ws (g)	365.47	365.47
Water Content, w (%)	10.31	18.71
Dry Unit Wt, γ_d (pcf)	102.6	105.2
Void ratio, e, for assumed Gs	0.61	0.50
Saturation (%), for assumed Gs	44.6	100 [a]
Average K[b] (cm/sec)	**7.1E-04**	

[a] Saturation set to 100% for phase calculations
[b] K corrected to 20°C

Optimum water content (%)	8.4	
Maximum dry unit weight (pcf)	107.5	
Gs	2.65	Assumed
Cell No.	4	
Station No.	3	
Permeant liquid used	De-aired tap water	
Total backpressure (psi)	39.5	
Effective horiz. consolidation stress (psi)	13.9	
Effective vert. consolidation stress (psi)	13.9	

	Initial (o)	Final (f)
B value	0.60	0.96
External Burette (cm^3)	18.30	32.20
Cell Pressure (psi)	0.0	53.4

Backpressure bottom (psi)	39.5
Backpressure top (psi)	39.5
System volume coefficient (cm^3/psi)	0.155
System volume change (cm^3)	8.29
Net sample volume change (cm^3)	-5.61
Bottom burette ground length, l_b (cm)	82.10
Top burette ground length, l_t (cm)	81.9
Burette area, a (cm^2)	0.197
Conversion, reading to cm head (cm/rd)	5.076

Start Date and Time: 3/25/13 8:18

Elapsed time (sec)	Bottom Burette (cm^3)	Top Burette (cm^3)	h_1 (cm)	h_2 (cm)	K (cm/sec)	Temp (°C)	Visc. Ratio R_t	K[b] (cm/sec)
40.0	0.00 3.42	10.00 6.60	50.96	16.34	7.4E-04	21.3	0.97	7.2E-04
35.0	0.00 3.16	10.00 6.86	50.96	18.98	7.4E-04	21.3	0.97	7.1E-04
35.0	0.00 3.16	10.00 6.86	50.96	18.98	7.4E-04	21.3	0.97	7.1E-04
35.0	0.00 3.14	10.00 6.86	50.96	19.08	7.3E-04	21.3	0.97	7.1E-04

Entered by:__________
Reviewed:__________

APPENDIX D

Runoff Curve Number and Runoff

Project:	CS Mining	By:	JMG	Date:	2/3/2014
Location:	CS Mining Tailings Pond	Checked:	JAH	Date:	2/3/2014
Condition:	Existing	Comments:	Potential Run-on West Drainage Area		

1. Runoff Curve Number

Soil Name and Hydrologic Soil Group	Cover Description	CN Table 2-2	CN Table 2-3	CN Table 2-4	Area (acres)	CNxArea
A-Sandy and Well Draine	Native Soils, Poor Ground Cover	63			72.7	4580.1
						0
						0
						0
						0
						0
						0
						0
						0
						0
						0
				TOTALS:	**72.7**	**4580.1**

CN Weighted: $\frac{\Sigma(\text{CNxArea})}{\Sigma(\text{Area})} = \frac{4580.1}{72.7} = 63$ **Use CN** → **63**

2. Runoff

		Storm #1 ARI (Year)	Storm #1 Duration	Storm #2 ARI (Year)	Storm #2 Duration	Storm #3 ARI (Year)	Storm #3 Duration
		100	24-hr				
Rainfall, P	in	2.99					
S	in	5.8730159					
I_a	in	1.1746032					
Runoff (Q)	in	0.4286536					

Technical Release 55
Urban Hydrology for Small Watersheds

Time of Concentration(T_c) or Travel Time (T_t)

Project:	CS Mining	By:	JMG	Date:	2/3/2014
Location:	CS Mining Tailings Pond	Checked:	JAH	Date:	2/3/2014
Condition:	Existing	Comments	Potential Run-on West Drainage Area		

Sheet Flow

		Segment ID	West		
1	Surface Description (Table 3-1)		Range (natural)		
2	Manning's Roughness Coefficient, n (Table 3-1)		0.13		
3	Flow Length, L (Total L ≤ 300 ft)	ft	300		
4	2-year, 24-hr Ranifall, P2	in	1.41		
5	Land Slope	ft/ft	0.3666667		
6	Tt	hr	0.1650561		0.1650561

Shallow Concentrated Flow

		Segment ID	West		
7	Surface Description		Unpaved		
8	Flow Length, L	ft	1848		
9	Land Slope	ft/ft	0.1212121		
10	Average Velocity, V (figure 3-1)		5.5		
11	Tt	hr	0.0933333		0.0933333

Channel Flow

		Segment ID	West		
	Flow Depth		1.2		
	Channel Side Slopes	?h:1V	4		
12	Cross Section flow area, a	ft^2	5.76		
13	Wetted Perimeter, Pw	ft	5.3665631		
14	Hydraulic Radius, r	ft	1.0733126		
15	Channel Slope, s	ft/ft	0.0227273		
	Channel Material	Earth	0.02		
	Degree of Irregularity	Minor	0.005		
	Relative effect of Obstruction	Appreciable	0.025		
	Vegetation	Low	0.0075		
	Degree of Meandering	Appreciable	1.15		
16	Manning's Roughness Coefficient, n		0.066125		
17	Velocity, V	ft/sec	3.5610527		
18	Flow Length, L	ft	1320		
19	T_t	hr	0.1029658		0.1029658
20	Watershed or Subarea T_c			hr	**0.3613552**

Technical Release 55
Urban Hydrology for Small Watersheds

Graphical Peak Discharge Method

Project:	CS Mining	By:	JMG	Date:	2/3/2014
Location:	CS Mining Tailings Pond	Checked:	JAH	Date:	2/3/2014
Condition:	Existing	Comments:	Potential Run-on West Drainage Area		

1 Data

Drainage Area, Am	mi^2	0.11359375
Runoff curve number	CN	63
T_c	hr	0.361355247
Rainfall Distribution		II
Pond or Swamp Areas	% of Am	0.0

		Storm #1	Storm #2	Storm #3
2 Frequency	yr	100		
Duration		24-hr		
3 Rainfall, P	in	2.99		
4 Initial Abstraction, I_a	in	1.174603		
5 Compute I_a/P		0.392844		
Tc	hr	0.361355		
6 Unit peak discharge, q_u	csm/in	420		
7 Runoff, Q	in	0.428654		
8 Pond and Swamp Factor, F_p		1		
9 Peak Discharge	ft^3/sec	**20.45079**		

Runoff Curve Number and Runoff

Project:	CS Mining	By:	JMG	Date:	2/3/2014
Location:	CS Mining Tailings Pond	Checked:	JAH	Date:	2/3/2014
Condition:	Existing	Comments:	Potential Run-on from East Drainage		

1. Runoff Curve Number

Soil Name and Hydrologic Soil Group	Cover Description	CN Table 2-2	CN Table 2-3	CN Table 2-4	Area (acres)	CNxArea
A-Sandy and Well Draine	Native Soils, Poor Ground Cover	63			11.2	705.6
						0
						0
						0
						0
						0
						0
						0
						0
						0
						0
				TOTALS:	**11.2**	**705.6**

CN Weighted: $\frac{\Sigma(\text{CNxArea})}{\Sigma(\text{Area})} = \frac{705.6}{11.2} = 63$ **Use CN** **63**

2. Runoff

		Storm #1 ARI (Year)	Storm #1 Duration	Storm #2 ARI (Year)	Storm #2 Duration	Storm #3 ARI (Year)	Storm #3 Duration
		100	24-hr				
Rainfall, P	in	2.99					
S	in	5.8730159					
I_a	in	1.1746032					
Runoff (Q)	in	0.4286536					

Technical Release 55
Urban Hydrology for Small Watersheds

Time of Concentration(T_c) or Travel Time (T_t)

Project:	CS Mining	By:	JMG	Date:	2/3/2014
Location:	CS Mining Tailings Pond	Checked:	JAH	Date:	2/3/2014
Condition:	Existing	Comments	Potential Run-on from East Drainage		

Sheet Flow

		Segment ID	East		
1	Surface Description (Table 3-1)		Range (natural)		
2	Manning's Roughness Coefficient, n (Table 3-1)		0.13		
3	Flow Length, L (Total L $\leq$ 300 ft)	ft	300		
4	2-year, 24-hr Ranifall, P2	in	1.41		
5	Land Slope	ft/ft	0.27		
6	Tt	hr	0.1865497		0.1865497

Shallow Concentrated Flow

		Segment ID	East		
7	Surface Description		Unpaved		
8	Flow Length, L	ft	458		
9	Land Slope	ft/ft	0.1386463		
10	Average Velocity, V (figure 3-1)		1.9		
11	Tt	hr	0.0669591		0.0669591

Channel Flow

		Segment ID	East		
	Flow Depth		0.45		
	Channel Side Slopes	?h:1V	4		
12	Cross Section flow area, a	ft^2	0.81		
13	Wetted Perimeter, Pw	ft	2.0124612		
14	Hydraulic Radius, r	ft	0.4024922		
15	Channel Slope, s	ft/ft	0.0925926		
	Channel Material	Earth	0.02		
	Degree of Irregularity	Minor	0.005		
	Relative effect of Obstruction	Appreciable	0.025		
	Vegetation	Low	0.0075		
	Degree of Meandering	Appreciable	1.15		
16	Manning's Roughness Coefficient, n		0.066125		
17	Velocity, V	ft/sec	3.7377798		
18	Flow Length, L	ft	1080		
19	T_t	hr	0.0802616		0.0802616
20	Watershed or Subarea T_c			hr	**0.3337704**

Technical Release 55
Urban Hydrology for Small Watersheds

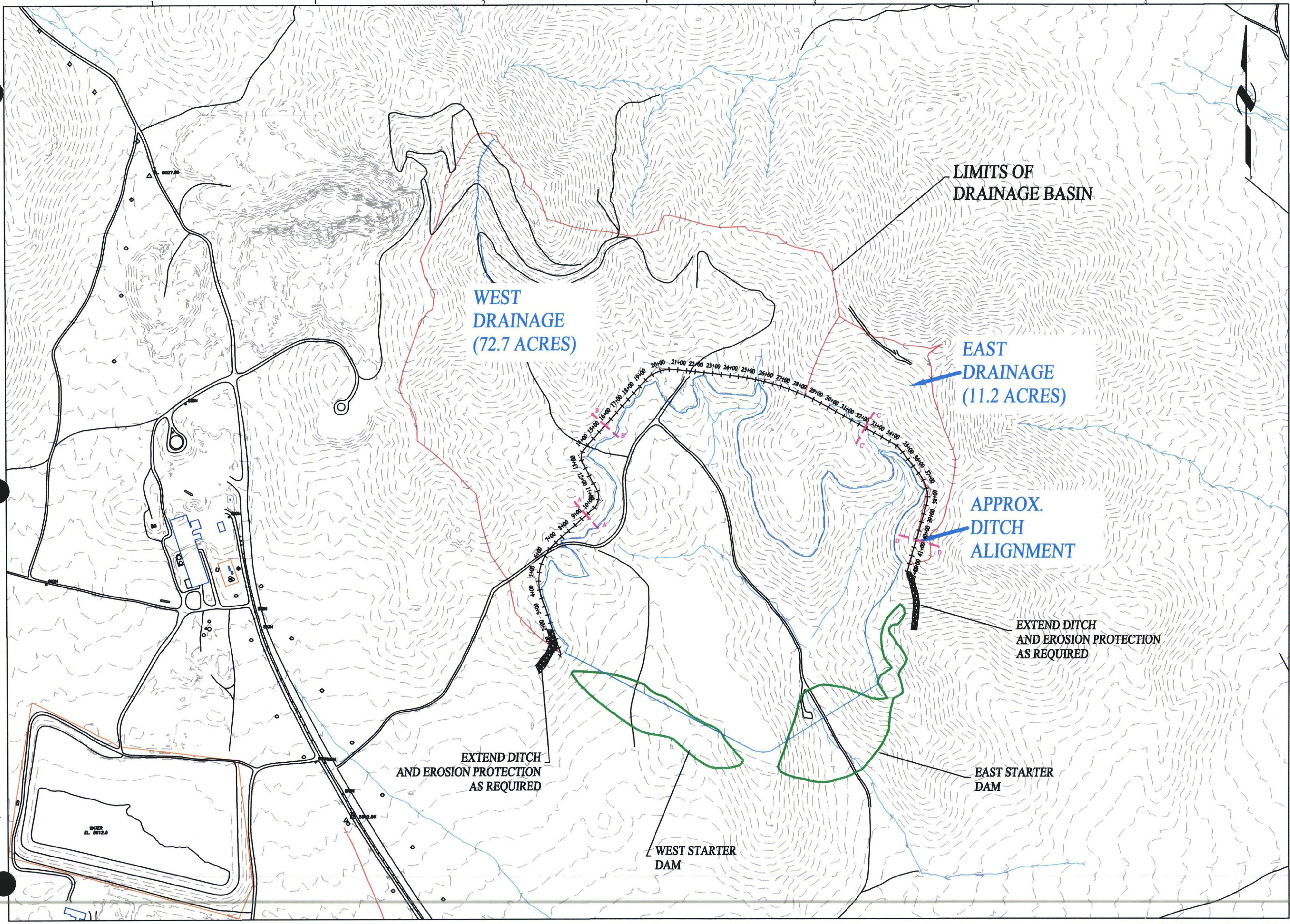
Graphical Peak Discharge Method

Project:	CS Mining	By:	JMG	Date:	2/3/2014
Location:	CS Mining Tailings Pond	Checked:	JAH	Date:	2/3/2014
Condition:	Existing	Comments:	Potential Run-on from East Drainage		

1 Data

Drainage Area, Am	mi^2	0.0175
Runoff curve number	CN	63
T_c	hr	0.333770361
Rainfall Distribution		II
Pond or Swamp Areas	% of Am	0.0

			Storm #1	Storm #2	Storm #3
2	Frequency	yr	100		
	Duration		24-hr		
3	Rainfall, P	in	2.99		
4	Initial Abstraction, I_a	in	1.174603		
5	Compute I_a/P		0.392844		
	Tc	hr	0.33377		
6	Unit peak discharge, q_u	csm/in	420		
7	Runoff, Q	in	0.428654		
8	Pond and Swamp Factor, F_p		1		
9	Peak Discharge	ft^3/sec	**3.150604**		



REFERENCE:
ADAPTED FROM MAP PROVIDED BY CLIENT
BASE TOPOGRAPHY FROM OLYMPUS AERIAL SURVEYS, JANUARY 2013

CS MINING

CS Mining
P.O. Box 608
1208 South 200 West
Milford, Utah 84751

CONSULTANTS

IGES®
ideas for a changing world
4153 South Commerce Drive
Salt Lake City, Utah 84107
(801)270-9400 Fax: (801)270-9401

— — EXISTING CONTOUR (10')
—— LIMITS OF DRAINAGE
—— LIMITS OF TAILINGS/WATER (ELEV 5858')
—— LIMITS OF EAST AND WEST STARTER DAM FILL

NOTES:

TOTAL DITCH LENGTH 42+44'

MARK	DATE	DESCRIPTION

ISSUE:

PROJECT NO.:	01640-002
CAD DWG FILE:	01640/CS WORKING.dwg
DRAWN BY:	JMG
DESIGNED BY:	JFW
CHECKED BY:	CS
COPYRIGHT:	IGES 2013

SHEET TITLE

CS MINING

DITCH ALIGNMENT

D-7

APPENDIX E

SITE GROUND MOTION [IBC SECTION 1615]

Project:	**CS Mining**	**Number:**	**01640-002**
Latitude =	**38.48214**	**Date:**	**1/30/13**
Longitude =	**-113.12016**	**By:**	**JMG**

Ss = 0.552 (g) The mapped spectral accleration for short periods [1615.1]

S_1 = 0.165 (g) The mapped spectral accleration for a 1-second period

Site Class = C Table 16.15.1.1

Fa = 1.18 Table 1615.1.2(1)

Fv = 1.64 Table 1615.1.2(2)

S_{MS} = 0.651 S_{MS} = Fa*Ss *The maximum considered E.Q. spectral resonse accelerations

S_{M1} = 0.270 S_{M1} = Fv*S_1 for short and 1-second periods [1615.1.2]

MCE/PGA = 0.260 **0.4*S_{MS} [Equation 16-42 in accordance with 1802.2.7 and 1615.2.1]**

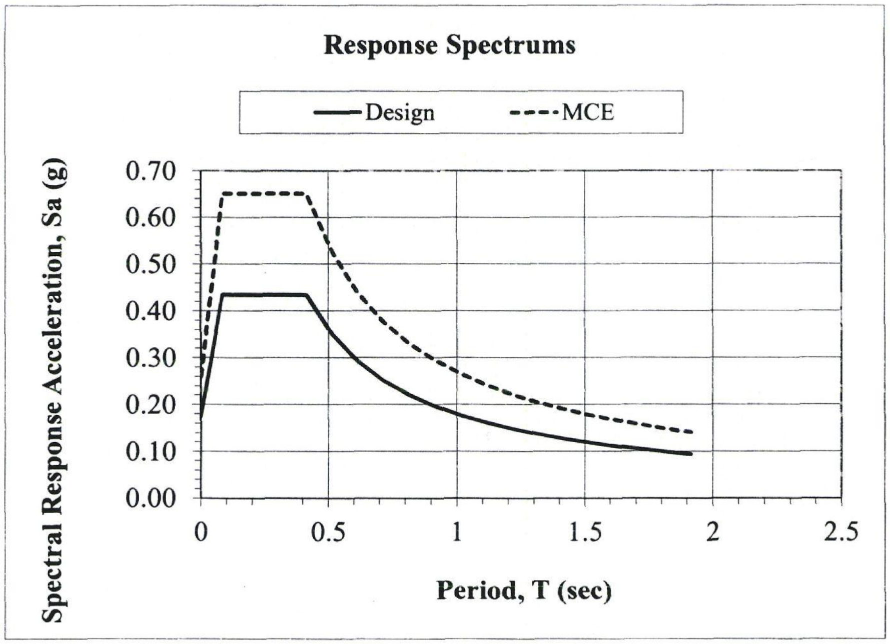
S_{DS} = 0.434 S_{DS} = 2/3*S_{MS} *The design spectral response acceleration

S_{D1} = 0.180 S_{D1} = 2/3*S_{M1} at short and 1-second periods

T_0 = 0.083 T_0 = 0.2*S_{D1}/S_{DS}

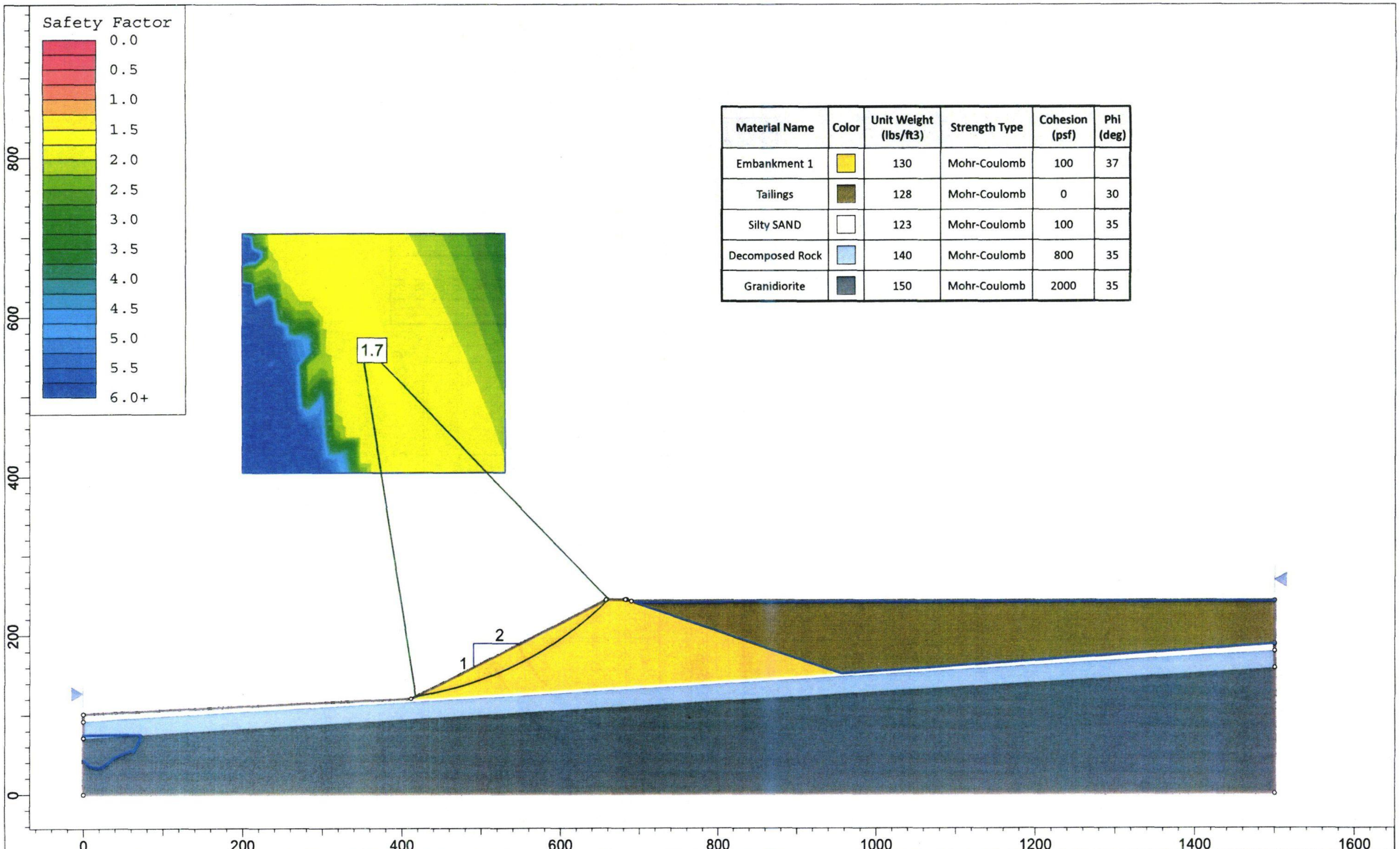
T_s = 0.414 T_s = S_{D1}/S_{DS}

ΔT = 0.1 Time step for diagram



T (sec)	Sa (g)	Sa (MCE) (g)
0	0.17	0.26
0.08	0.43	0.65
0.41	0.43	0.65
0.51	0.35	0.52
0.61	0.29	0.44
0.71	0.25	0.38
0.81	0.22	0.33
0.91	0.20	0.30
1.01	0.18	0.27
1.11	0.16	0.24
1.21	0.15	0.22
1.31	0.14	0.21
1.41	0.13	0.19
1.51	0.12	0.18
1.61	0.11	0.17
1.71	0.10	0.16
1.81	0.10	0.15
1.91	0.09	0.14

IGES

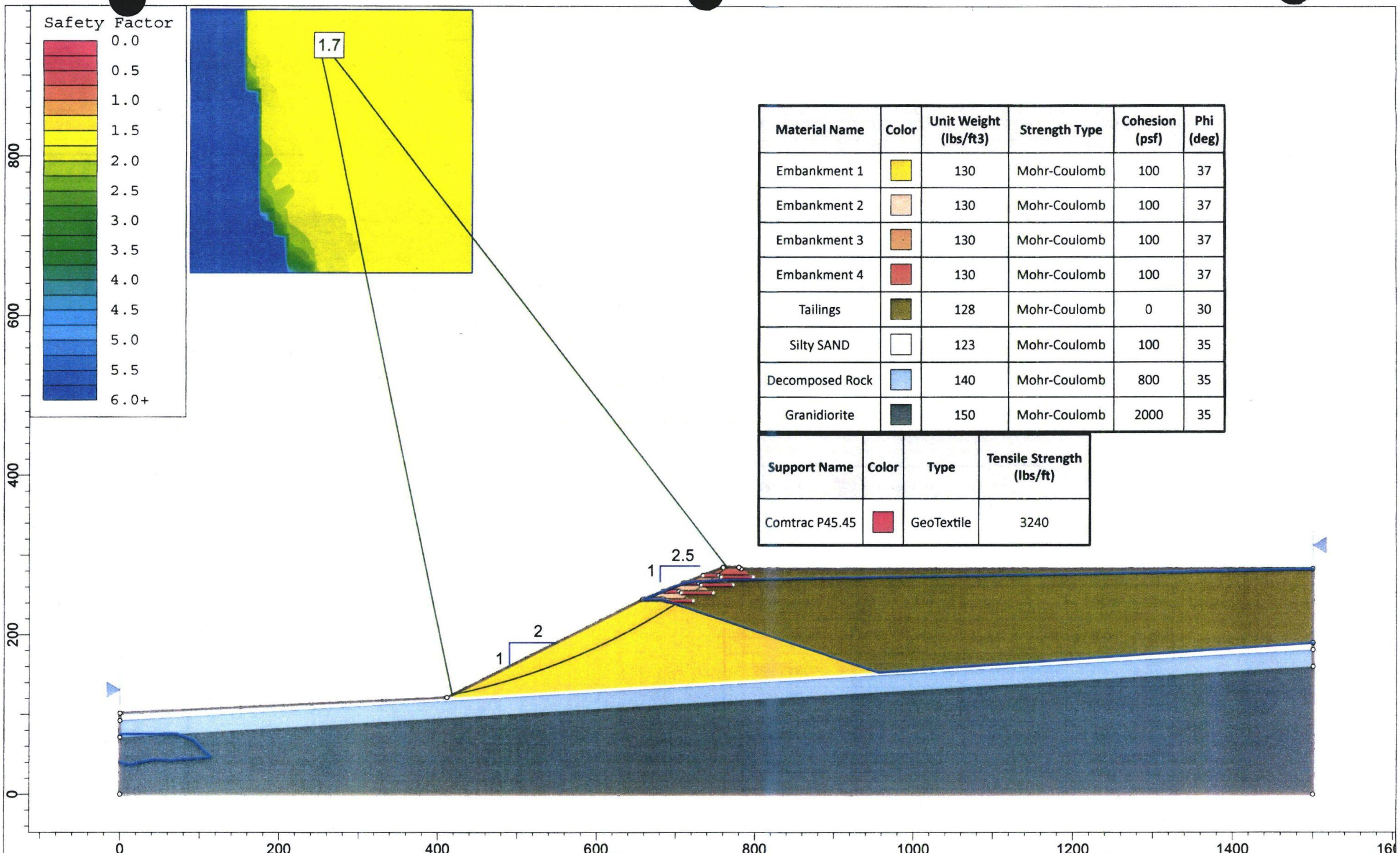


Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Embankment 1		130	Mohr-Coulomb	100	37
Tailings		128	Mohr-Coulomb	0	30
Silty SAND		123	Mohr-Coulomb	100	35
Decomposed Rock		140	Mohr-Coulomb	800	35
Granidiorite		150	Mohr-Coulomb	2000	35

IGES®

Project	Section A-A' - Downstream Lined Embankment to 5820'		
Analysis Description	Long Term		
Drawn By JMG	*Scale* 1:2000	*Company*	IGES, Inc
Date	1/15/2014	*File Name*	Section A-A' - 5820 - Long Term.slim

SLIDEINTERPRET 6.025



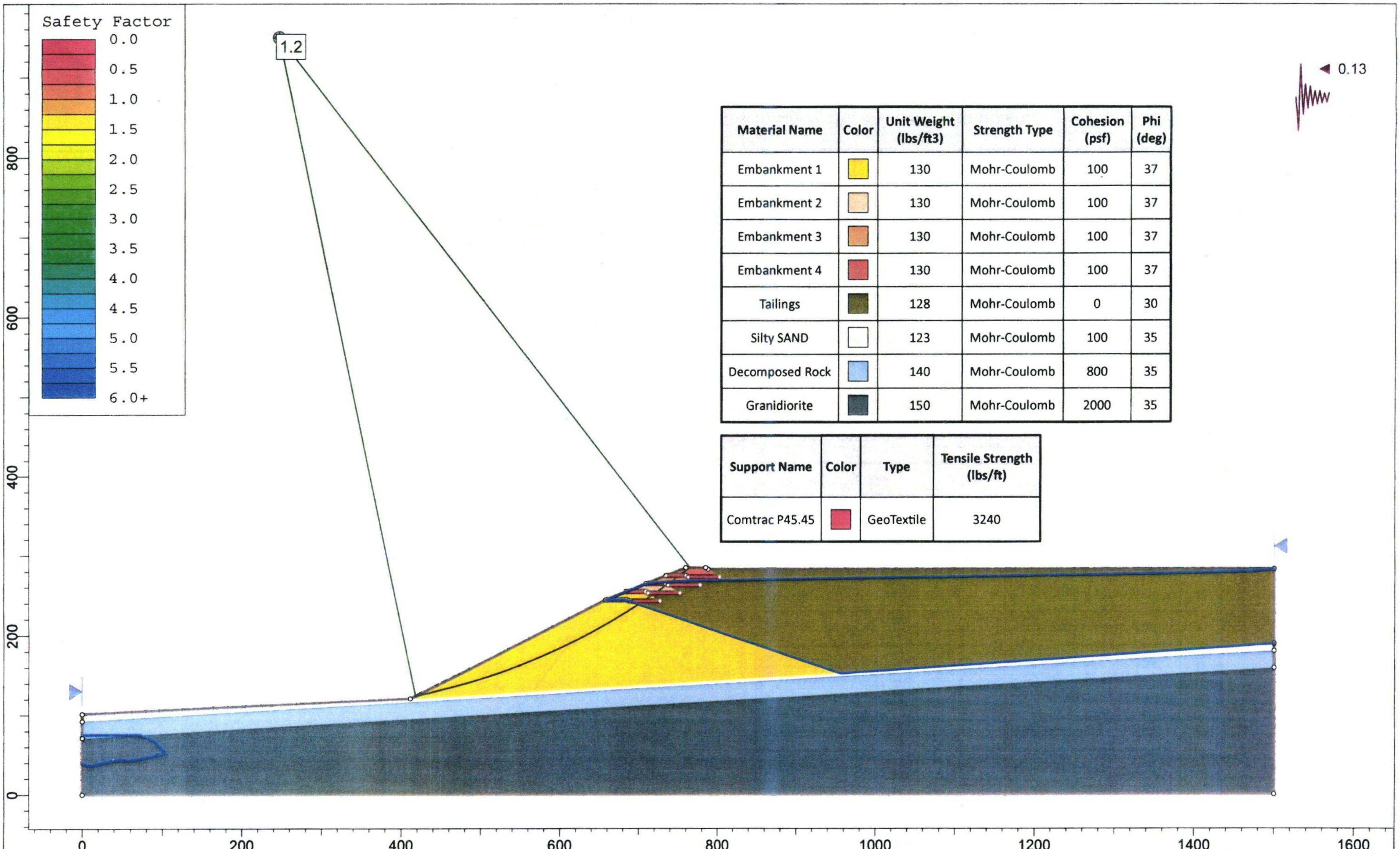
Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Embankment 1		130	Mohr-Coulomb	100	37
Embankment 2		130	Mohr-Coulomb	100	37
Embankment 3		130	Mohr-Coulomb	100	37
Embankment 4		130	Mohr-Coulomb	100	37
Tailings		128	Mohr-Coulomb	0	30
Silty SAND		123	Mohr-Coulomb	100	35
Decomposed Rock		140	Mohr-Coulomb	800	35
Granidiorite		150	Mohr-Coulomb	2000	35

Support Name	Color	Type	Tensile Strength (lbs/ft)
Comtrac P45.45		GeoTextile	3240

IGES®

SLIDEINTERPRET 6.025

Project	Section A-A' - Downstream Lined Embankment with Upstream Raises to 5860'
Analysis Description	Long Term
Drawn By	JMG
Scale	1:2000
Company	IGES, Inc
Date	1/15/2014
File Name	Section A-A' - 5860 - Long Term.slim



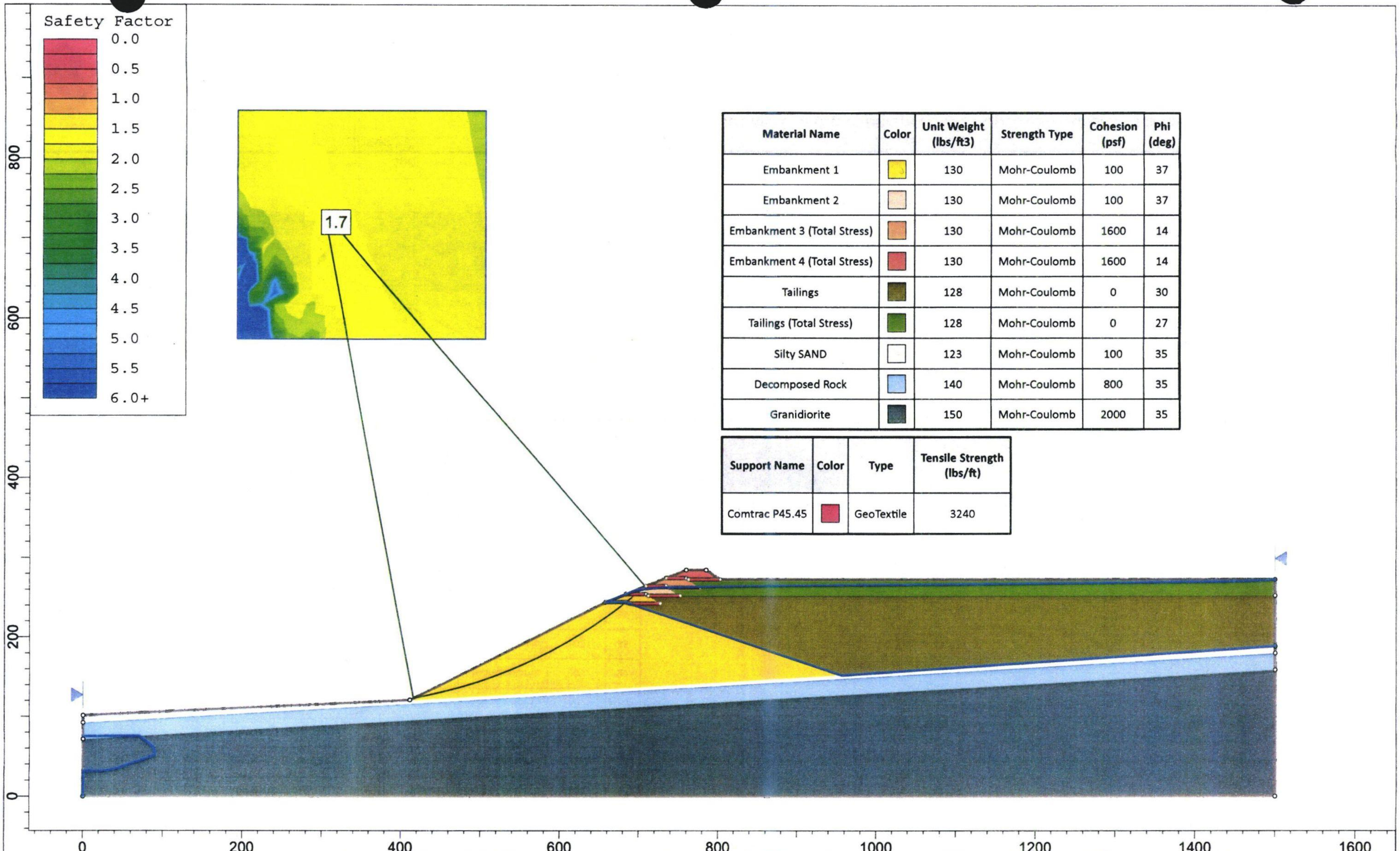
Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Embankment 1		130	Mohr-Coulomb	100	37
Embankment 2		130	Mohr-Coulomb	100	37
Embankment 3		130	Mohr-Coulomb	100	37
Embankment 4		130	Mohr-Coulomb	100	37
Tailings		128	Mohr-Coulomb	0	30
Silty SAND		123	Mohr-Coulomb	100	35
Decomposed Rock		140	Mohr-Coulomb	800	35
Granidiorite		150	Mohr-Coulomb	2000	35

Support Name	Color	Type	Tensile Strength (lbs/ft)
Comtrac P45.45		GeoTextile	3240

IGES®

Project	Section A-A' - Downstream Lined Embankment with Upstream Raises to 5860'		
Analysis Description	Pseudodynamic		
Drawn By JMG	*Scale* 1:2000	*Company* IGES, Inc	
Date 1/15/2014		*File Name* Section A-A' - 5860 - Long Term - Pseudodynamic.slim	

SLIDEINTERPRET 6.025



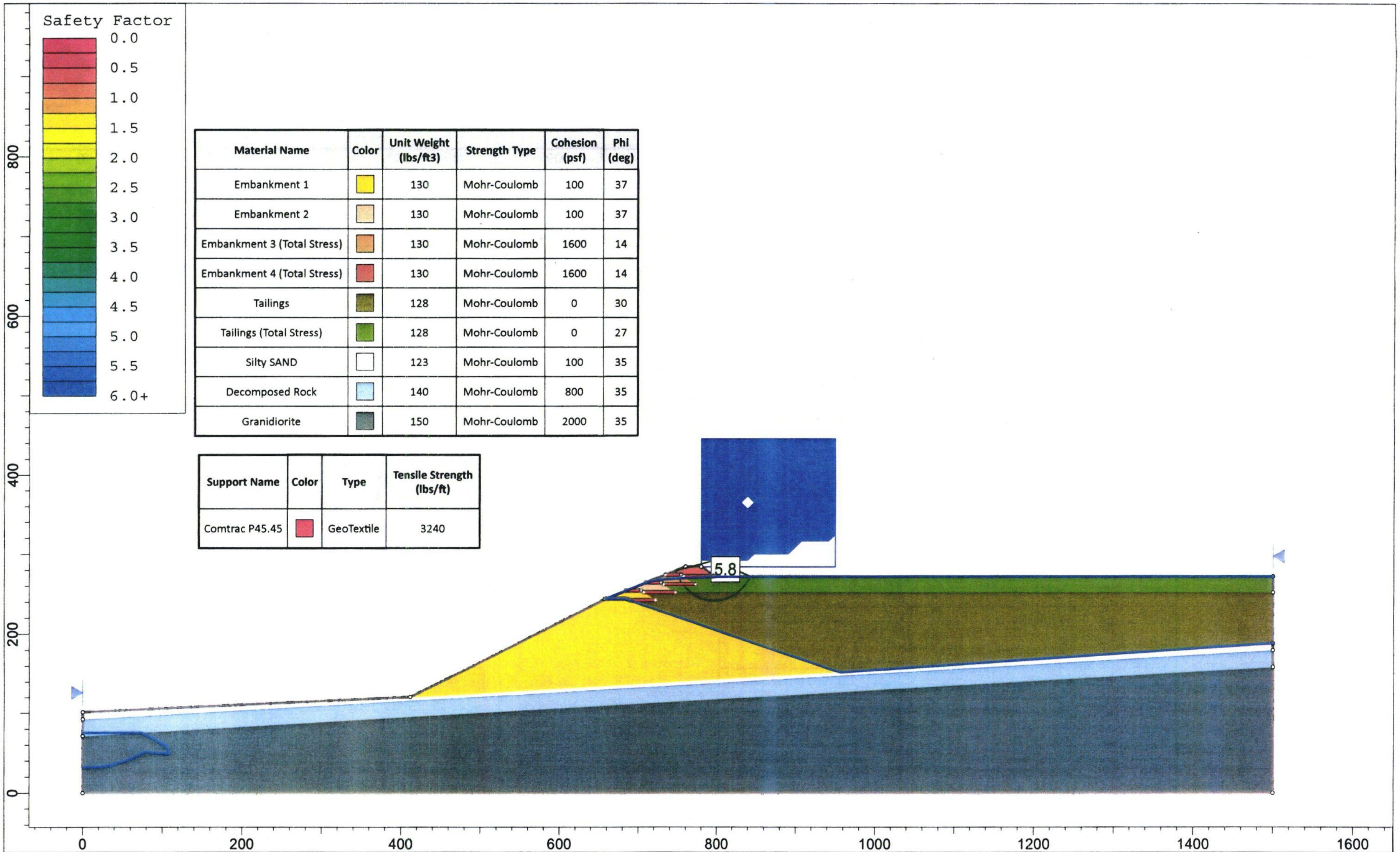
Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Embankment 1		130	Mohr-Coulomb	100	37
Embankment 2		130	Mohr-Coulomb	100	37
Embankment 3 (Total Stress)		130	Mohr-Coulomb	1600	14
Embankment 4 (Total Stress)		130	Mohr-Coulomb	1600	14
Tailings		128	Mohr-Coulomb	0	30
Tailings (Total Stress)		128	Mohr-Coulomb	0	27
Silty SAND		123	Mohr-Coulomb	100	35
Decomposed Rock		140	Mohr-Coulomb	800	35
Granidiorite		150	Mohr-Coulomb	2000	35

Support Name	Color	Type	Tensile Strength (lbs/ft)
Comtrac P45.45		GeoTextile	3240

IGES®

SLIDEINTERPRET 6.025

Project	Section A-A' - Downstream Lined Embankment with Upstream Raises to 5860'		
Analysis Description	EOC		
Drawn By JMG	*Scale* 1:2000	*Company*	IGES, Inc
Date	1/15/2014	*File Name*	Section A-A' - 5860 - EOC.slim



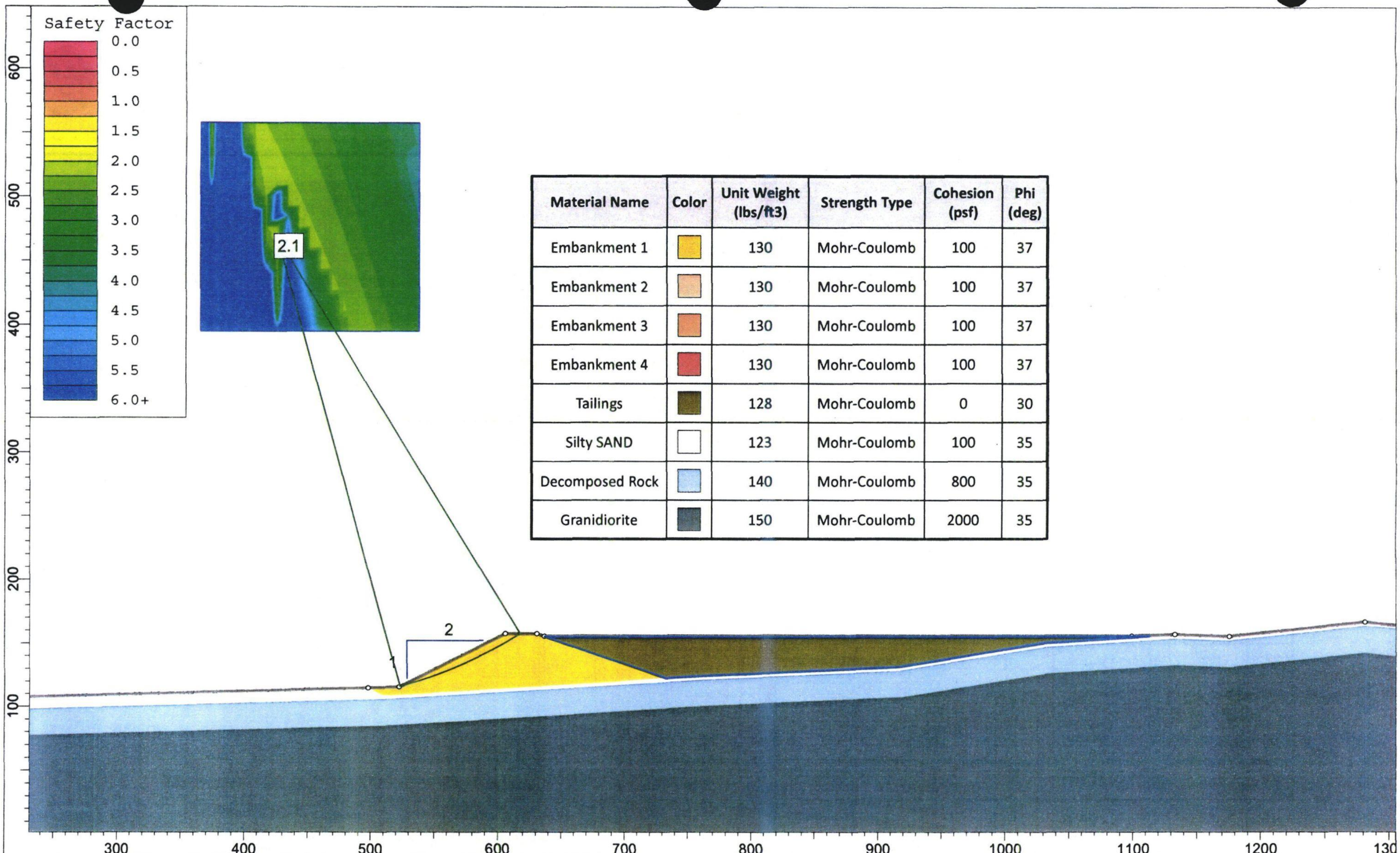
Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Embankment 1		130	Mohr-Coulomb	100	37
Embankment 2		130	Mohr-Coulomb	100	37
Embankment 3 (Total Stress)		130	Mohr-Coulomb	1600	14
Embankment 4 (Total Stress)		130	Mohr-Coulomb	1600	14
Tailings		128	Mohr-Coulomb	0	30
Tailings (Total Stress)		128	Mohr-Coulomb	0	27
Silty SAND		123	Mohr-Coulomb	100	35
Decomposed Rock		140	Mohr-Coulomb	800	35
Granidiorite		150	Mohr-Coulomb	2000	35

Support Name	Color	Type	Tensile Strength (lbs/ft)
Comtrac P45.45		GeoTextile	3240

IGES®

SLIDEINTERPRET 6.025

Project	Section A-A' - Downstream Lined Embankment with Upstream Raises to 5860'		
Analysis Description	EOC Upstream Case		
Drawn By JMG	*Scale* 1:2000	*Company*	IGES, Inc
Date 1/15/2014		*File Name*	Section A-A' - 5860 - EOC - Upstream Case.slim

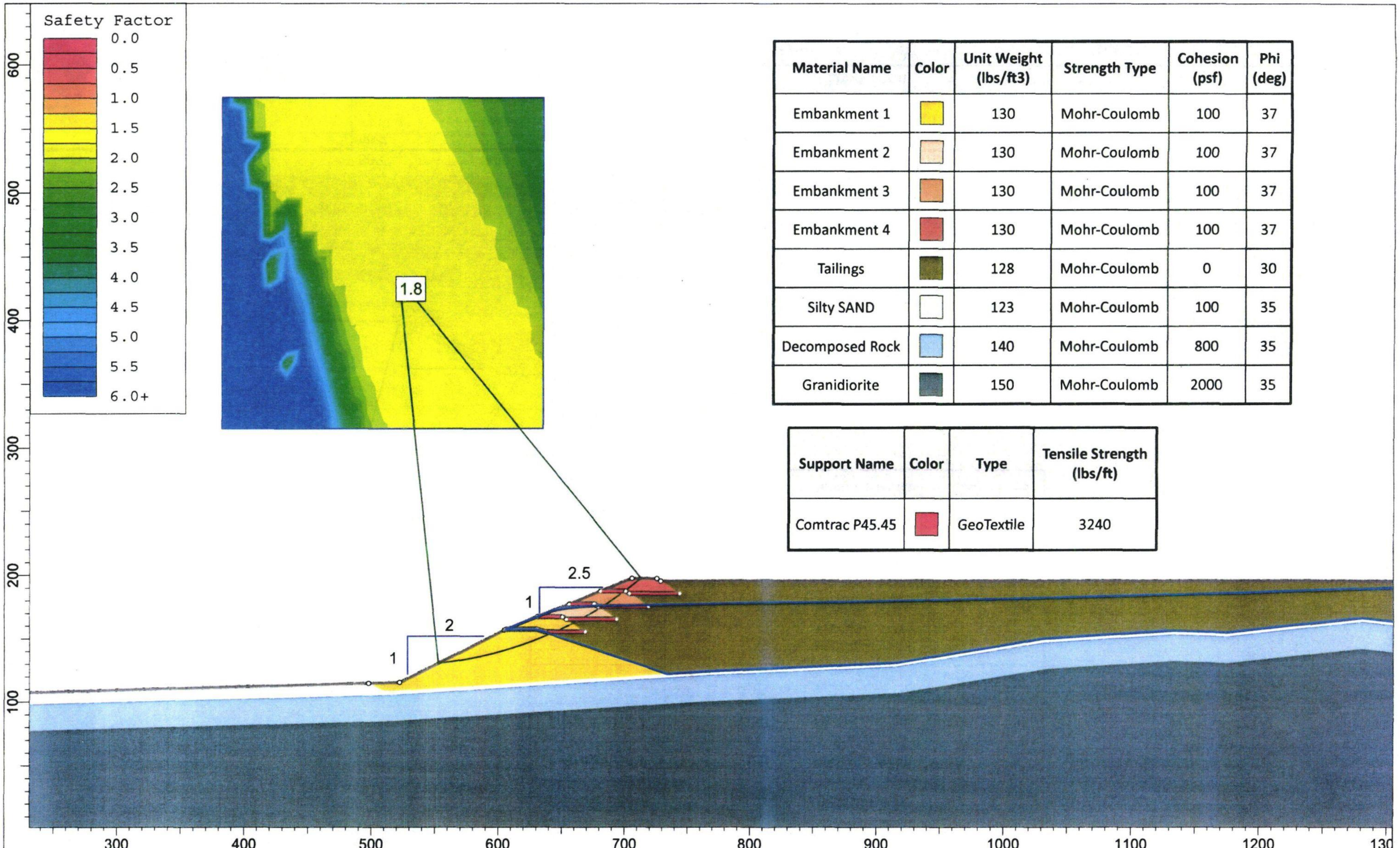


Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Embankment 1		130	Mohr-Coulomb	100	37
Embankment 2		130	Mohr-Coulomb	100	37
Embankment 3		130	Mohr-Coulomb	100	37
Embankment 4		130	Mohr-Coulomb	100	37
Tailings		128	Mohr-Coulomb	0	30
Silty SAND		123	Mohr-Coulomb	100	35
Decomposed Rock		140	Mohr-Coulomb	800	35
Granidiorite		150	Mohr-Coulomb	2000	35

IGES®

SLIDEINTERPRET 6.025

Project	Section B-B' - Downstream Lined Embankment to 5820'		
Analysis Description	Long Term		
Drawn By JMG	*Scale* 1:1250	*Company*	IGES, Inc
Date 1/15/2014		*File Name*	Section B-B' - 5820 - Long Term.slim

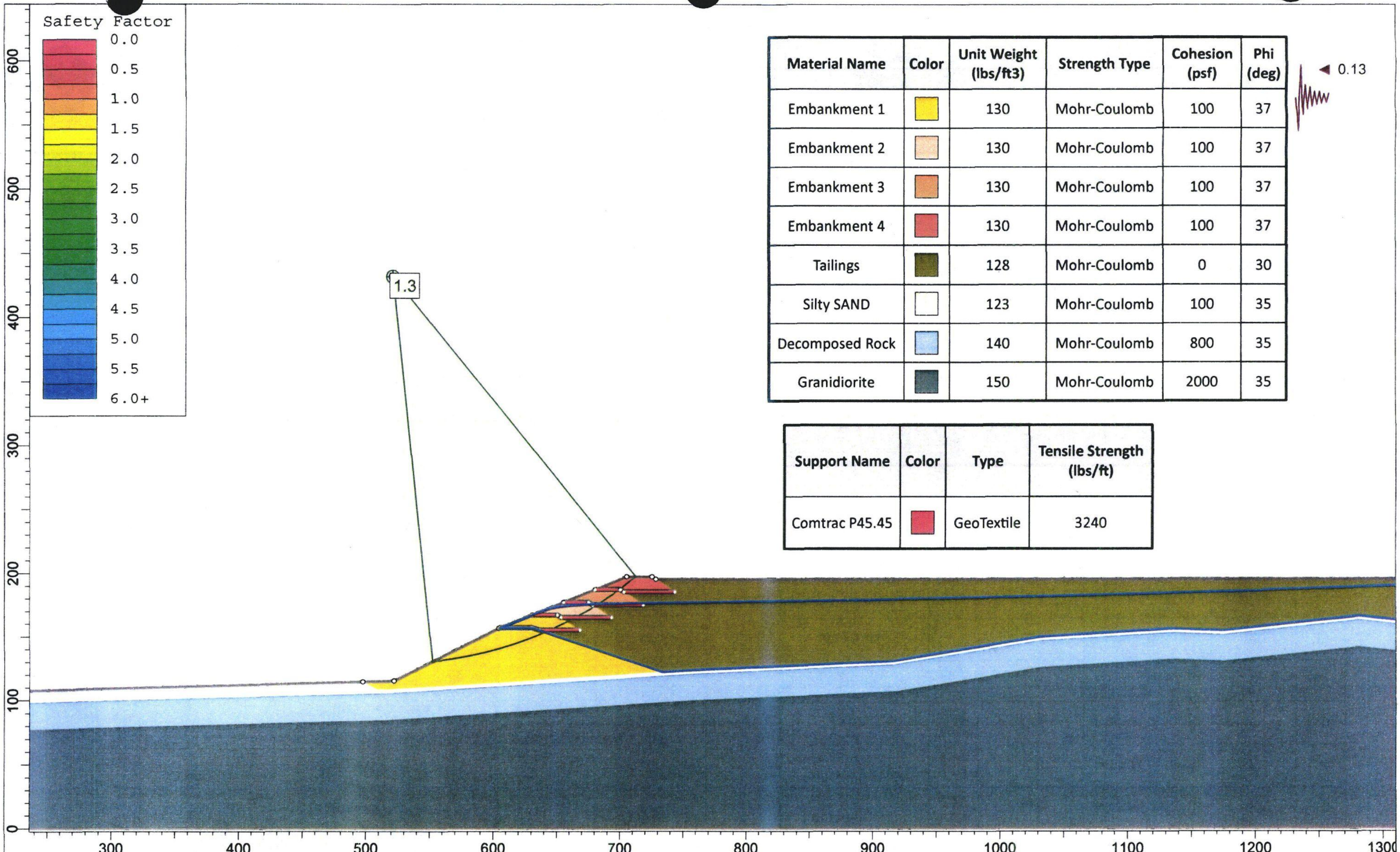


Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Embankment 1		130	Mohr-Coulomb	100	37
Embankment 2		130	Mohr-Coulomb	100	37
Embankment 3		130	Mohr-Coulomb	100	37
Embankment 4		130	Mohr-Coulomb	100	37
Tailings		128	Mohr-Coulomb	0	30
Silty SAND		123	Mohr-Coulomb	100	35
Decomposed Rock		140	Mohr-Coulomb	800	35
Granidiorite		150	Mohr-Coulomb	2000	35

Support Name	Color	Type	Tensile Strength (lbs/ft)
Comtrac P45.45		GeoTextile	3240

IGES®	*Project* Section B-B' - Downstream Lined Embankment with Upstream Raises to 5860'		
	Analysis Description Long Term		
	Drawn By JMG	*Scale* 1:1250	*Company* IGES, Inc
SLIDEINTERPRET 6.025	*Date* 1/15/2014		*File Name* Section B-B' - 5860 - Long Term.slim

E-



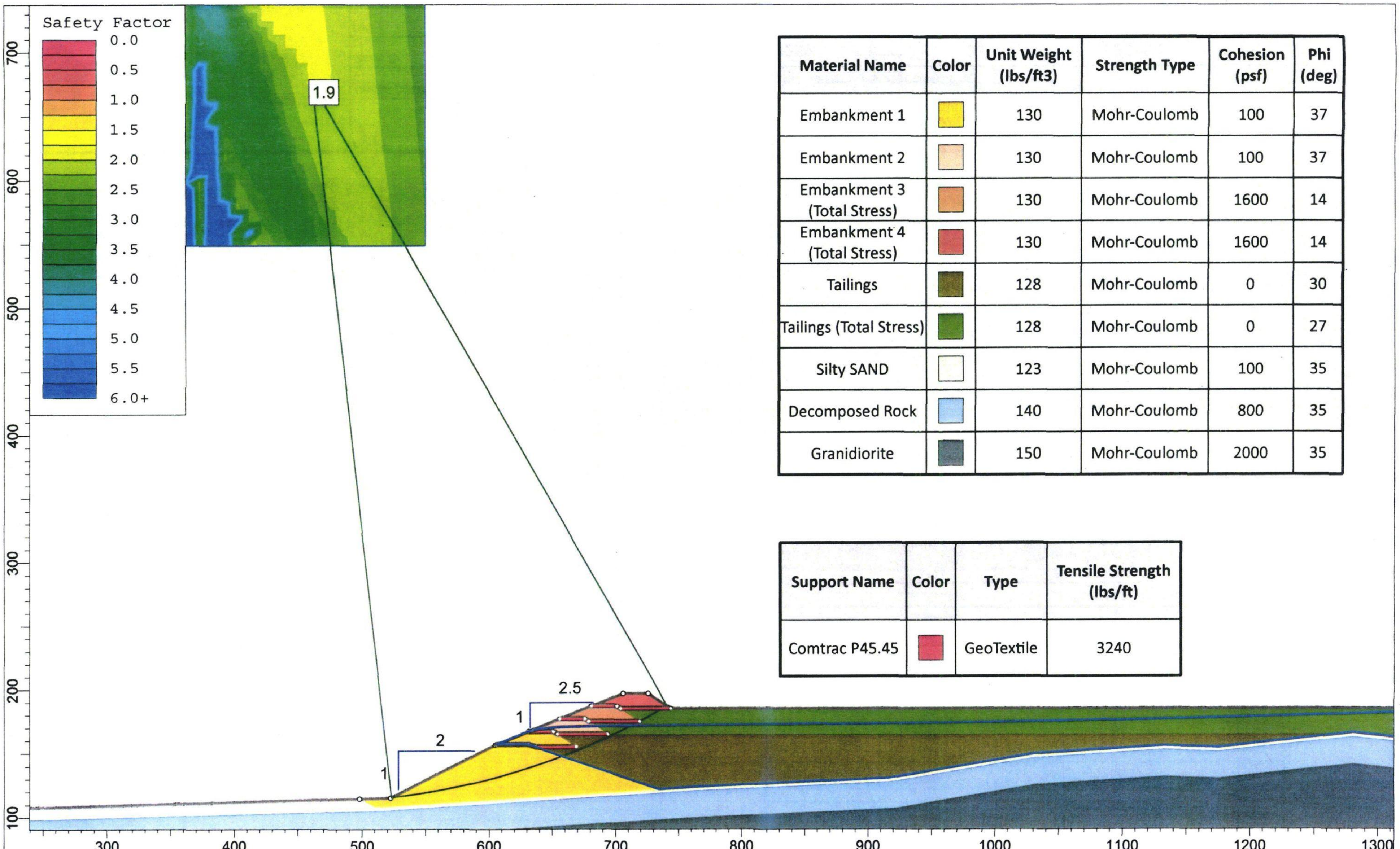
Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Embankment 1		130	Mohr-Coulomb	100	37
Embankment 2		130	Mohr-Coulomb	100	37
Embankment 3		130	Mohr-Coulomb	100	37
Embankment 4		130	Mohr-Coulomb	100	37
Tailings		128	Mohr-Coulomb	0	30
Silty SAND		123	Mohr-Coulomb	100	35
Decomposed Rock		140	Mohr-Coulomb	800	35
Granidiorite		150	Mohr-Coulomb	2000	35

Support Name	Color	Type	Tensile Strength (lbs/ft)
Comtrac P45.45		GeoTextile	3240

IGES®

SLIDEINTERPRET 6.025

Project	Section B-B' - Downstream Lined Embankment with Upstream Raises to 5860'
Analysis Description	Long Term - Pseudodynamic
Drawn By	JMG
Scale	1:1250
Company	IGES, Inc
Date	1/15/2014
File Name	Section B-B' - 5860 - Long Term - Pseudodynamic.slim



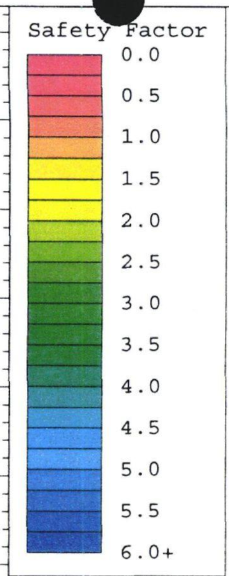
Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Embankment 1		130	Mohr-Coulomb	100	37
Embankment 2		130	Mohr-Coulomb	100	37
Embankment 3 (Total Stress)		130	Mohr-Coulomb	1600	14
Embankment 4 (Total Stress)		130	Mohr-Coulomb	1600	14
Tailings		128	Mohr-Coulomb	0	30
Tailings (Total Stress)		128	Mohr-Coulomb	0	27
Silty SAND		123	Mohr-Coulomb	100	35
Decomposed Rock		140	Mohr-Coulomb	800	35
Granidiorite		150	Mohr-Coulomb	2000	35

Support Name	Color	Type	Tensile Strength (lbs/ft)
Comtrac P45.45		GeoTextile	3240

IGES®

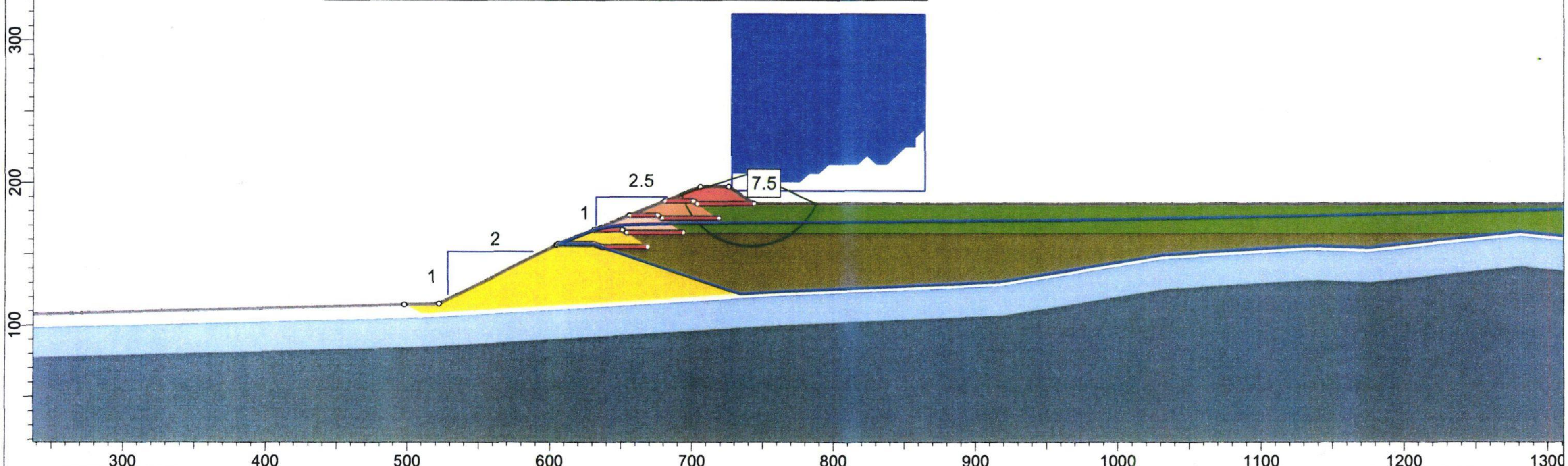
SLIDEINTERPRET 6.025

Project	Section B-B' - Downstream Lined Embankment with Upstream Raises to 5860'		
Analysis Description	EOC		
Drawn By: JMG	Scale: 1:1250	Company	IGES, Inc
Date: 1/15/2014		File Name	Section B-B' - 5860 - EOC.slim



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Embankment 1		130	Mohr-Coulomb	100	37
Embankment 2		130	Mohr-Coulomb	100	37
Embankment 3 (Total Stress)		130	Mohr-Coulomb	1600	14
Embankment 4 (Total Stress)		130	Mohr-Coulomb	1600	14
Tailings		128	Mohr-Coulomb	0	30
Tailings (Total		128	Mohr-Coulomb	0	27
Silty SAND		123	Mohr-Coulomb	100	35
Decomposed Rock		140	Mohr-Coulomb	800	35
Granidiorite		150	Mohr-Coulomb	2000	35

Support Name	Color	Type	Tensile Strength (lbs/ft)
Comtrac P45.45		GeoTextile	3240



IGES®

SLIDEINTERPRET 6.025

Project	Section B-B' - Downstream Lined Embankment with Upstream Raises to 5860'
Analysis Description	EOC - Upstream
Drawn By	JMG
Scale	1:1250
Company	IGES, Inc
Date	1/15/2014
File Name	Section B-B' - 5860 - EOC - Upstream.slim

APPENDIX F

TECHNICAL SPECIFICATIONS

For

PHASE 1 ITDF East Starter Dam
CS MINING

Division 1 – General Requirements

Division 2 – Site Work

DIVISION 1 - GENERAL REQUIREMENTS

SECTION 01011

SUMMARY OF PROJECT

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Work included

B. Summary of Work

C. Definitions

1.2 RELATED SECTIONS

A. Section 01039 – Project Coordination and Meetings

B. Section 01300 – Submittals

C. Section 01500 – Temporary Controls

D. Section 01600 – Materials, Labor, and Equipment

E. Section 01700 – Contract Closeout

1.3 WORK INCLUDED

A. Construction of ITDF East Starter Dam and initial lining of impoundment. Work includes clearing, grubbing and stockpiling of topsoil, excavation and grading of side slopes, fill placement, anchor trench construction, placement of 40-mil smooth HDPE, and construction of access road and adjoining diversion ditch. Installation of piping and barge pumpback system to be performed by others.

Work includes excavation, importation (from onsite source), and placement of approximately 415,000 cubic yards of soil. Final subgrade preparation and certification of base soil for placement of HDPE liner.

Furnish and install approximately 1,300,000 square feet of smooth 40-mil high-density polyethylene (HDPE) geomembrane.

1.4 SUMMARY OF WORK

A. The construction of the Phase 1 East Starter Dam will be the first stage of the systematic ITDF facility development. Construction of the western (second) starter dam and basin lining will follow as Phase 2 of the project. Subsequent expansion will include a series of sequentially constructed upstream raises as tailings beach development occurs adjacent to each of the starter dams. CONTRACTOR to perform the following work:

- Submit Health and Safety Plan to OWNER for review and approval
- Submit Construction Schedule to OWNER for review and approval
- Submit Earthmoving Plan to OWNER for review and approval

B. Clear and grub vegetation and approximately 6-12 inches of topsoil from beneath the starter dam footprint and throughout the basin where liner will be constructed to the maximum anticipated tailings impoundment level.

C. Prepare dam foundation area by overexcavating, replacement and compaction of up to uppermost 15 feet of foundation soil. Excavate, haul, place, moisture condition and compact fill materials from within the impoundment in order to develop starter dam prism.

D. Perform final subgrade preparation for placement of HDPE. Preparation of subgrade includes mass excavation and mass fill operations including compaction of fill soil. CONTRACTOR is required to certify, in writing (subgrade acceptance form), that the subgrade soil is adequate for the installation of liner materials prior to placement of HDPE.

E. Furnish and install 40-mil smooth HDPE as detailed on the construction drawings. Drawings included with the bid package are for bidding purposes only. Final locations and final details will be confirmed with the issue of construction drawings prior to work commencing. Quantities are not expected to change more than ten percent (10%) from bidding documents to construction documents.

F. All products are to be installed or placed in accordance with standards required by respective manufacturer.

G. Anchor geomembrane securely in place to prevent the movement of installed materials. Anchoring of all materials shall be performed with sandbags, anchor trenches or other ENGINEER approved methods.

H. Sequence installation to ensure that all operations are achieved in an orderly and expeditious manner.

I. Touch-up minor damaged surfaces caused during delivery, storage, handling and installation. Replace damaged components as necessary.

J. Installation will not be considered complete until the liner and other materials are completely inspected by the QA Inspector.

1.5 DEFINITIONS

A. CONTRACTOR, The term "CONTRACTOR" shall be used to describe the various work activities of both the prime CONTRACTOR and all of the subcontractors for which the CONTRACTOR retains responsibility.

B. ENGINEER, the term "ENGINEER" shall be used to describe the design engineer responsible for the structural design of the starter dam, site preparation and subgrade recommendations, liner system, and the specifications therein.

C. OWNER, the term "OWNER" shall be used in the specifications herein to describe CS Mining and its affiliates.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

Not Used.

END OF SECTION

SECTION 01039

PROJECT COORDINATION AND MEETINGS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Prime CONTRACTOR Responsibilities

B. Preconstruction Meeting

C. Daily Meetings

D. Weekly Meetings

E. Work Deficiency Meetings

1.2 RELATED SECTIONS

A. Section 01011 – Summary of Project

B. Section 01300 – Submittals

C. Section 01500 – Temporary Controls

D. Section 01600 – Materials, Labor and Equipment

E. Section 01700 – Contract Closeout

1.3 PRIME CONTRACTOR RESPONSIBILITY

A. Coordination

1. The prime CONTRACTOR shall properly coordinate all work. Expediting the work of the various trades as necessary so that the different elements are built and installed in proper sequence and so that the parts fit together in a neat, tight, and professional manner and function properly and as intended at completion of the work without interruption of continued operation of the tailings impoundment operations.

2. The CONTRACTOR shall see to it that orders for manufactured items, which he is to furnish as called for under this contract and specifications and under his direction, are ordered by the various trades involved and are delivered to the site at the proper time.

3. The CONTRACTOR and the various trades working under his leadership and direction shall coordinate their work with adjacent work and with other trades so as to facilitate the general progress of the work. Each trade shall afford other trades every reasonable opportunity for the installation of their work and for the storage of their material.

B. Conformity with Plans

1. The CONTRACTOR shall perform all work in conformity with the drawings, specifications, QA/QC Plan and instructions from the ENGINEER.

2. All minor details of the work, which are not specifically mentioned in the specifications, but are obviously incidental, shall be considered a part of the work for which prices are given in the proposal, and no extra compensation shall be allowed the CONTRACTOR for the performance thereof.

C. Errors and Omissions

1. If the CONTRACTOR, in the course of the work, finds any errors or omissions in plans or in the layout as given by survey points and instructions, or if he finds any discrepancy between the plans and the physical conditions of the locality, he shall promptly verify the same and notify the OWNER. Any work done after such discovery, until authorized, will be done at the CONTRACTOR's risk.

D. Notice to OWNER

1. The CONTRACTOR shall give forty-eight hours notice when he will need the services of the OWNER for staking out any portion of the work.

E. Lines and Grades

1. All work shall be done to the true line and grade, as indicated by the Drawings.

2. The OWNER will furnish initial survey control points and the CONTRACTOR must protect them and will be held responsible for any defective work caused by his negligence in this respect.

3. If the survey control points are destroyed or if additional points are needed, the OWNER will furnish them to the CONTRACTOR, and the CONTRACTOR shall reimburse the OWNER for the additional expense of reestablishing the survey control points.

F. Supervisory Personnel

1. It is the intent of these specifications to provide a completed project, which will in every way reflect the work of competent journeymen in the various trades represented.

2. The CONTRACTOR shall insure that each portion of the work is supervised by a qualified person, well versed in the operation of the various tools required for the trade, the method in which the work is to be done, and knowledge of the general requirements of the construction

work.

3. All work is to be done in accordance with the latest methods devised for such work to insure a professional appearance of the completed project.

1.4 MEETINGS

A. A Preconstruction Meeting will be held with OWNER, ENGINEER, QA Personnel, and all CONTRACTORS and their QC Personnel to facilitate project schedule and coordination. CONTRACTOR shall submit preliminary schedule at Preconstruction meeting and provide weekly updates as work progresses. The State of Utah Division of Water Quality (DWQ) personnel may attend the Preconstruction meeting at their option. The meeting will be documented by the QA Inspector or ENGINEER on a Meeting Documentation form.

B. A Daily Progress Meeting will be held with attendance required by the CONTRACTOR, the QC Inspector, and the QA Inspector. The meeting will be documented by the QA Inspector on a Meeting Documentation form. The purpose of the meeting will be to:

- Review the previous day's work
- Review the work location and activities
- Discuss any problems

C. A Weekly Progress meeting will be held with attendance required by the CONTRACTOR, the QC Inspector, the QA Inspector, and OWNER. The ENGINEER and State of Utah DWQ personnel may attend at their option. The meeting will be documented by the QA Inspector on a Meeting Documentation form. The purpose of the meeting will be to:

- Review minutes of previous meetings.
- Review of Work progress and updated schedule.
- Field observations, problems, and decisions.
- Identification of problems that impede planned progress.
- Review of submittals schedule and status of submittals.
- Review of off-site fabrication and delivery schedules.
- Maintenance of progress schedule.
- Corrective measures to regain projected schedules.
- Planned progress during succeeding work period.
- Coordination of projected progress.
- Maintenance of quality and work standards.
- Effect of proposed changes on progress schedule and coordination.
- Other business relating to Work.

D. A Work Deficiency Meeting will be held if or when any work items are identified to be deficient. Attendance will be required by the CONTRACTOR, the QC Inspector, the QA Inspector, ENGINEER, and OWNER. The meeting will be documented by the QA Inspector on a Meeting Documentation form. The State of Utah DWQ personnel may attend at their option. The purpose of the meeting will be to:

- Review the Problem Identification/Corrective Measures Reports
- Review the Corrective Action Items
- Discuss any problems

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

Not Used.

END OF SECTION

SECTION 01300

SUBMITTALS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Submittal Procedures

B. Proposed Products List

C. Product Data

D. Certificates

E. Manufacturer's Instructions

1.2 RELATED SECTIONS

A. Section 01011 – Summary of Project

B. Section 01039 – Project Coordination and Meetings

C. Section 01500 – Temporary Controls

D. Section 01600 – Materials, Labor and Equipment

E. Section 01700 – Contract Closeout

1.3 SUBMITTAL PROCEDURES

A. Collect submittals from all manufacturers or suppliers and provide to ENGINEER for written approval of products.

B. Identify manufacturer or supplier and reference appropriate drawing and/or specification location.

C. Identify variations from Contract Documents and Product or system limitations that may be detrimental to successful performance of the completed Work.

D. Obtain written approval of materials from ENGINEER prior to ordering from vendor.

E. When revised for resubmission, identify all changes made since previous submission.

F. Distribute copies of reviewed submittals as appropriate. Instruct parties to promptly report any inability to comply with requirements.

1.4 PROPOSED PRODUCTS LIST

A. Within 15 days after date of Notice to Proceed, submit list of major products proposed for use, with name of manufacturer, trade name and model number of each product.

B. For products specified only by reference standards, give manufacturer, trade name, model or catalog designation, and reference standards.

1.5 PRODUCT DATA

A. Product Data for Review:

1. Submitted to ENGINEER for review for the limited purpose of checking for conformance with Plans and Specifications

B. Submit one copy to OWNER.

C. Mark copy to identify applicable products, models, options, and other data. Supplement manufacturers' standard data to provide information specific to this project.

1.6 CERTIFICATES

A. When specified in individual specification sections, submit certification by the manufacturer, installation/application subcontractor, to the ENGINEER.

B. Indicate material or product conforms to or exceeds specified requirements. Submit supporting reference data, affidavits, and certifications as appropriate.

C. Certificates may include recent or previous test results on material or Product, but must be acceptable to ENGINEER.

1.7 MANUFACTURER'S INSTRUCTIONS

A. When specified in individual specification sections, submit printed instructions for delivery, storage, installation and maintenance to CONTRACTOR and ENGINEER. ENGINEER will forward instructions to QA personnel.

B. Indicate special procedures, perimeter conditions requiring special attention, and special environmental criteria required for application or installation.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

Not Used.

END OF SECTION

SECTION 01500

TEMPORARY CONTROLS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Site Safety

1.2 RELATED SECTIONS

A. Section 01011 – Summary of Project

B. Section 01039 – Project Coordination and Meetings

C. Section 01300 – Submittals

D. Section 01600 – Materials, Labor and Equipment

E. Section 01700 – Contract Closeout

1.3 SITE SAFETY

A. The CONTRACTOR shall ensure that proper care is exercised to make the work safe at all times.

1. Materials, equipment or other obstructions shall not be strung or placed on or in any traveled roadways in a manner that will be hazardous to vehicles or personnel and shall provide and maintain at all times, and as directed by the OWNER for the protection of all traffic operating in work areas.

2. If in the operation of equipment it becomes necessary to encroach upon the above mentioned traveled roadway or at any point that may be construed by the OWNER as dangerous to traffic or personnel, the CONTRACTOR shall place guards, at his expense, to direct and inform site persons of existing danger.

B. The CONTRACTOR shall be held responsible for any costs or schedule impacts through mishaps or accidents caused by his neglect or the neglect of any of his employees or agents in the performance of the work involved in the handling of this project work. No additional costs will be allowed by the OWNER for this added protection.

PART 2 – PRODUCTS

Not Used

PART 3 – EXECUTION

Not Used

END OF SECTION

SECTION 01600

MATERIALS, LABOR, AND EQUIPMENT

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. CONTRACTOR Provided Materials, Labor, and Equipment

1.2 RELATED SECTIONS

A. Section 01011 – Summary of Project

B. Section 01039 – Project Coordination and Meetings

C. Section 01300 – Submittals

D. Section 01500 – Temporary Controls

E. Section 01700 – Contract Closeout

1.3 CONTRACTOR PROVIDED MATERIALS, LABOR, AND EQUIPMENT

A. The CONTRACTOR shall furnish all labor, materials, equipment, tools, supervision, etc., and all costs involved, necessary to complete the work required under this contract as specified, including all power required to power all tools and equipment used, such as gasoline, fuel, oil, electricity, etc.

B. All equipment, tools, machinery, etc. used shall be in good repair and shall be maintained in a good workable and safe condition necessary to continuously carry on the work involved in this project in a professional, expeditious and safe manner, without serious or costly delays in the performance of all phases of the work involved.

C. Use of any and all equipment and machinery on this project shall be in accordance with all applicable MSHA standards.

D. The CONTRACTOR shall provide all safety equipment at the CONTRACTOR's expense.

E. No equipment or machinery shall be operated in or over paved streets or prepared roadway shoulders, in getting to, from or in working on this project that is equipped with treads or cleats that, in the opinion of the OWNER, may be injurious to pavement or shoulder surfaces.

F. Any damage done under these circumstances shall be immediately repaired by the CONTRACTOR at the CONTRACTOR's expense.

G. If requested by the OWNER or the ENGINEER, the CONTRACTOR shall furnish a list of all equipment and machinery that he has of his own or that he has access to, which he proposes to use for this project. The CONTRACTOR shall state the present condition of equipment as to its fitness and safety on this type of work, together with a written statement as to the past experiences of those who will operate the various machines to be used, their qualifications and the previous experiences the CONTRACTOR has had in performing similar work as that required under this contract.

PART 2 – PRODUCTS

Not Used

PART 3 – EXECUTION

Not Used

END OF SECTION

SECTION 01700

CONTRACT CLOSEOUT

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Closeout procedures.

B. Final cleaning.

C. Project record documents.

D. Warranties and bonds.

1.2 RELATED SECTIONS

A. Section 01011 – Summary of Project

B. Section 01039 – Project Coordination and Meetings

C. Section 01300 – Submittals

D. Section 01500 – Temporary Controls

E. Section 01600 – Materials, Labor and Equipment

1.3 CLOSOUT PROCEDURES

A. Submit written certification that Contract Documents have been reviewed, Work has been inspected, and that Work is complete in accordance with Contract Documents and ready for OWNER and ENGINEER's review.

B. Provide to OWNER all Project Record Documents.

C. Submit final Application for Payment identifying total adjusted Contract Sum, previous payments, and sum remaining due.

1.4 FINAL CLEANING

A. Execute final cleaning prior to final project assessment.

B. Remove waste and surplus materials, rubbish, and construction facilities from the site.

1.5 PROJECT RECORD DOCUMENTS

A. Maintain on site one set of the following record documents; record actual revisions to the Work:

1. Drawings.
2. Specifications.
3. Addendums.
4. Change Orders and other modifications to the Contract.
5. Product Data, and Samples.
6. Manufacturer's instruction for installation, and repairing.
7. All documents specified in the project QA/QC Plan.

B. Ensure entries are complete and accurate, enabling future reference by OWNER.

C. Store record documents separate from documents used for construction.

D. Record information concurrent with construction progress.

E. Specifications: Legibly mark and record at each product section, a description of actual Products installed, including the following:

1. Manufacturer's name and product model and number.
2. Product substitutions or alternates utilized.
3. Changes made by Addenda and modifications.

F. Record Drawings [and Shop Drawings]: Legibly mark each item to record actual construction including:

1. Measured horizontal and vertical locations of underground installations, referenced to permanent surface improvements.
2. Field changes of dimension and detail.
3. Details not on original Contract drawings.

G. Submit documents to OWNER with claim for final Application for Payment

1.6 WARRANTIES AND BONDS

A. Provide notarized copies.

B. Execute and assemble transferable warranty documents from Subcontractors, suppliers, and manufacturers.

C. Provide Table of Contents and assemble in ring binder with durable cover.

D. Submit prior to final Application for Payment.

E. For items of Work delayed beyond date of Substantial Completion, provide updated submittal within 10 days after acceptance, listing date of acceptance as start of warranty period.

PART 2 – PRODUCTS

Not Used.

PART 3 – EXECUTION

Not Used.

END OF SECTION

DIVISION 2 – SITE WORK

SECTION 02200

SITE PREPARATION

PART 1 – GENERAL

1.1 SECTION INCLUDES

A. Definitions

B. Quality Assurance

C. Project Conditions

D. Sequencing and Scheduling

1.2 RELATED SECTIONS

A. Section 02300 – Earthwork

B. Section 02400 – Subgrade Preparation

C. Section 02714 – Geotextile Fabric

D. Section 02771 – 40-mil HDPE

1.3 DEFINITIONS

A. Clearing: Consists of removal of natural obstructions and existing foundations, buildings, fences, lumber, walls, stumps, brush, weeds, rubbish, trees, boulders, utility lines, and any other items which interferes with construction operations or are designated for removal.

B. Grubbing: Consists of the removal and disposal of wood or root matter below the ground surface remaining after clearing and includes stumps, trunks, roots, or root systems greater than 1 inch in diameter or thickness to a depth of 6 inches below the ground surface.

C. Stripping: Includes the removal and disposal of all organic sod, topsoil, grass and grass roots, and other objectionable material remaining after clearing and grubbing from the areas designated to be stripped. The depth of stripping is estimated to be 6 – 12 inches, but the required depth of stripping will be determined by the ENGINEER. All stripped topsoil materials shall be delivered and stored in a stockpile area designated by the OWNER for future use in reclamation.

1.4 QUALITY ASSURANCE

A. Regulatory requirements: Verify and comply with applicable regulations regarding those governing noise, dust, nuisance, drainage and runoff, fire protection, and disposal.

B. Meetings: Attend meetings with all parties as described in Specification 01039 Section 1.4.

1.5 PROJECT CONDITIONS

A. Existing conditions:
   1. Verify character and amount of clay, sand, gravel, quicksand, water, rock, hardpan, and other material involved and work to be performed.

1.6 SEQUENCING AND SCHEDULING

A. Clearing and grubbing: Perform clearing and grubbing in advance of grading operations.

PART 2 – PRODUCTS

Not Used.

PART 3 – EXECUTION

3.1 EXAMINATION

A. Verification of conditions: Examine site and verify existing conditions before beginning work.

3.2 PREPARATION

A. Protect existing improvements from damage by site preparation work.

3.3 INSTALLATION

A. Clearing:

   1. Clear areas where construction is to be performed, including borrow areas and other areas as indicated on the Drawings, or specified in this Section, of topsoil, stumps, brush, roots, weeds, trees, shrubs, rubbish, and other objectionable material of any kind which, if left in place, would interfere with proper performance or completion of the work, would impair its subsequent use, or form obstructions. Borrow area topsoil shall be stockpiled in an area designated by the OWNER.

   2. It is the CONTRACTOR's responsibility to determine the effort needed to remove shrubs, brush, rocks, and objectionable materials required for construction activities.

   3. Do not incorporate organic material from clearing and grubbing operations in

fills and backfills.

4. CONTRACTOR's construction facilities: Fill or remove pits, fill, and other earthwork required for erection of facilities, upon completion of the work, and level to meet existing contours of adjacent ground.

B. Grubbing:

1. From ITDF basin area:

a. Grub stumps, roots, and other obstructions 1 inch to 3inches in diameter or thickness to 6 inches below grade.

b. Grub stumps or roots 3 inches or over in diameter to depth of not less than 18 inches below finish grade.

c. Sharp rocks or other deleterious materials that could perforate the liner shall not be in contact with the liner material. Remove material or grade area such that deleterious material is covered by 6 inches of compacted site soils.

2. In embankment areas or other areas to be cleared outside construction area: Do not leave stumps, roots, and other obstructions higher than the following requirements:

Height of Embankment over Stump	Depth of Clearing and Grubbing
0 feet to 2 feet	Grub stumps or roots 3 inches or over in diameter to 18 inches below original grade. Cut others flush with ground.
2 feet to 3 feet	Grub stumps 1 foot and over in diameter to 18 inches below original grade. Cut others flush with ground.
Over 3 feet	Leave no stumps higher than stump top diameter, and in no case more than 18 inches.

3. Backfill and compact cavities left below subgrade elevation by removal of stumps or roots to density of adjacent undisturbed soil.

C. Stripping:

1. Remove soil material containing sod, grass, or other vegetation to depth of 6 – 12 inches from both borrow areas and areas to receive fill.

2. Deposit stripped material at locations as directed by OWNER.

END OF SECTION

SECTION 02300

EARTHWORK

PART 1 GENERAL

1.1 SUMMARY

A. Section includes:
   1. Loosening, excavating, filling, grading, borrow, hauling, preparing subgrade, compacting in final location, wetting and drying, and operations pertaining to site grading for embankment construction.
   2. Backfilling and compacting to support embankment construction.

1.2 RELATED SECTIONS

A. Section 02200 – Site Preparation

B. Section 02400 – Subgrade Preparation

C. Section 02714 – Geotextile Fabric

D. Section 02771 – 40-mil HDPE

1.3 REFERENCES

A. Latest Version of American Society for Testing and Materials (ASTM) Standards:
   1. D 1556 - Standard Test Method for Density and Unit Weight of Soil in Place by the Sand Cone Method.
   2. D 698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft3 (600 kN m/m^3)).
   3. D 2922 - Standard Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
   4. D 3017 - Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth).

1.4 DEFINITIONS

A. Backfill adjacent to structure: Backfill within volume bounded by the exterior surfaces of structure, the surface of undisturbed soil in the excavation around structure, and finish grade around structure.

B. Embankments: Dikes, levees, berms, and similar facilities.

C. Excavation: Consists of loosening, removing, loading, transporting, depositing, and compacting in final location, wet and dry materials, necessary to be removed for purposes of construction of structures, ditches, grading, berms, roads, and such other purposes as are indicated on the Drawings.

1.5 SYSTEM DESCRIPTION

A. Performance requirements:
   1. Where soft or unstable material is encountered, such materials shall be removed and replaced with suitable properly compacted materials.
   2. Obtain acceptable import material from other sources if surplus obtained within Project site do not conform to specified requirements or are not sufficient in quantity.
   3. No extra compensation will be made for hauling of fill materials or for water required for compaction.

1.6 SUBMITTALS

A. Copy of Property OWNER's Agreement allowing placement of surplus soil material on their property.

B. Excavation plan.

C. Testing lab: Submit CONTRACTOR's proposed testing laboratory capabilities and equipment.

D. Test reports:
   1. Submit certified test reports of all tests specified to be performed by the CONTRACTOR.
   2. Sign and seal test reports by a registered PROFESSIONAL ENGINEER who practices geotechnical engineering and is registered in the State of Utah.

1.7 QUALITY ASSURANCE

A. Initial compaction demonstration:
   1. Adequacy of compaction equipment and procedures: Demonstrate adequacy of compaction equipment and procedures before exceeding any of following amounts of earthwork quantities:
      a. 100 linear feet of trench backfill.
      b. 50 cubic yards of backfill adjacent to structures.
      c. 100 cubic yards of embankment work.
      d. 100 cubic yards of fill.
      e. 50 cubic yards of roadway base material.
      f. 100 cubic yards of road fill.
   2. Compaction sequence requirements: Until specified degree of compaction on previously specified amounts of earthwork is achieved, do not perform additional earthwork of the same kind.
   3. After satisfactory conclusion of initial compaction demonstration and at any time during construction, provide confirmation tests as specified under the QA/QC Plan.

1.8 SEQUENCING AND SCHEDULING

A. Schedule earthwork operations to meet requirements specified in this Section for excavation and uses of excavated material.

B. If necessary, stockpile excavated material for later use at locations specified by the OWNER.

C. Excavation, backfilling, and filling: Perform excavation, backfilling, and filling during construction in manner and sequence that provides drainage away from critical work areas at all times.

PART 2 – PRODUCTS

1.1 MATERIALS

A. Water for compacting: Use water from source acceptable to ENGINEER as directed by OWNER.

B. Soil and rock materials:
  1. General:
    a. Provide native material and select material where specified or indicated on the Drawings.
    b. If suitable surplus materials are available, obtain native material and select material from cut sections or excavations or from borrow areas.

C. Geotextile fabrics:
  1. Stabilization fabric: As specified in Section 02714.

PART 3 – EXECUTION

3.1 EXAMINATION

A. Verification of conditions:
  1. Character and quantity of material:
    a. Verify character and quantity of rock, gravel, sand, silt, water, and other inorganic or organic materials to be encountered in work to be performed.
    b. Determine gradation and shrinkage, and swelling of soil, and suitability of material for use intended in work to be performed.
    c. Determine quantity of material, and cost thereof, required for construction of backfills, cuts, embankments, excavations, fills, and roadway fills, whether from onsite excavations, or borrow areas. Include in cost of work to be performed.
    d. Include wasting of excess material, if required, in cost of work to be performed.

3.2 PREPARATION

A. Starter Dam Foundation:
  1. Starter dam foundation areas, after clearing is completed, overexcavate a

minimum of 5 feet and up to 12 feet as determined by the ENGINEER. Excavated materials will be used as structural embankment and replacement fills.

2. Scarify and recompact scarified areas to density specified for embankments before replacing and compacting excavated foundation soils.
3. Overexcavated and replacement fill soils shall be placed in 8 inch loose lifts, moisture conditioned and compacted to the requirements of embankment structural fill materials.

B. Sloped surfaces for fill or foundations:
   1. Foundations for fill having slopes in excess of 1 vertical to 4 horizontal:
      a. Bench or terrace to adequately key existing ground and fill built thereon.
   2. Slopes of original hillsides and old fills: Bench minimum of 10 feet horizontally as fill is placed.
   3. Provision of new benches:
      a. Start new bench wherever vertical cut of next lower bench intersects existing grade.
      b. Recompact material thus cut out along with new embankment material at no additional cost to the OWNER.

3.3 INSTALLATION

A. General:
   1. Dispose of unsuitable excavated materials as determined by the ENGINEER, which are not required or are unsuitable for fill and backfill in lawful manner.
   2. Dispose of surplus material on private property only when written permission agreement is furnished by OWNER of property. Submit copies of such agreements.
   3. Obtain material required in excess of suitable material produced by cuts and excavation, from borrow areas subject to the material requirements specified.
   4. Rocks, broken concrete, or other solid materials larger than 4 inches in greatest dimension: Remove from project site at no additional cost to OWNER.
   5. Stabilization of subgrade: Provide materials used, or perform work required, to stabilize subgrade so it can withstand loads which may be placed upon it by CONTRACTOR's equipment.

B. Borrow area: If there is insufficient borrow area on Project site, import material from off-site.
   1. Where material is required, import material from source located off Project site selected by the CONTRACTOR and subject to acceptance by the ENGINEER.
   2. There will be no additional cost to the Contract for use of imported material.

C. Compaction:
   1. Provide specified compaction for backfills, cuts, embankments, fills, roadway fills, and other earthwork.
   2. Perform confirmation tests to verify and confirm that work has complied, and is complying at all times, with compaction requirements specified in this Section for initial compaction demonstration and field quality control testing.
   3. In-place density of compacted backfills, cuts, embankments, fills, and roadway fills determined in accordance with ASTM D 1556, or with ASTM D 2922 and ASTM D 3017.
   4. Maximum density obtained in laboratory when tested in accordance with

ASTM D 698.

5. To prevent damage to structures due to backfilling operations, place backfill with equipment that does not exceed H-20 loading, within a distance from the face of the structure of not less than 1/2 the depth of backfill. The depth of backfill is the distance between the level being compacted and the bottom of the excavation. Outside this distance, heavier compaction equipment may be used.
6. Compact to percentage of maximum density as follows:
   a. Utility trenches: 95 percent
   b. Embankments: 95 percent.
   c. Intermediate dikes 90 percent.
   d. Other non-structural areas: 85 percent.
   e. Spoil areas 85 percent.
   f. Under roadways, parking and storage areas, curbs, and sidewalks: 95 percent.
   g. Upper 6 inches of cuts: 95 percent.
   h. Fills: 95 percent.

D. Materials for backfills, embankments, fills, roadway fills:
   1. General:
      a. Obtain import material from other sources if surplus materials from within Project site or borrow areas do not conform to specified requirements or are not sufficient in quantity for construction of Project.
   2. Embankments:
      a. Native material, Select material, or imported material meeting the requirements of native material, select material, unless otherwise specified or indicated on the Drawings.
   3. Fills:
      a. Native material, or imported material meeting the requirements of select material unless otherwise specified or indicated on the Drawings.

E. Placement:
   1. General:
      a. Lines and grades:
         1) Construct backfills, embankments, fills, and road fills, at locations and to lines and grades indicated on the Drawings.
         2) Overbuild all permanent fill slopes by at least 1 foot and then cut to final grade to provide adequate compaction of the remaining fill.
   2. Embankments:
      a. Place loose material in successive layers that do not exceed 8 inches in loose thickness.
      b. Soil may be placed in loose lifts up to 12 inches in thickness, at the ENGINEER's discretion, if the CONTRACTOR's means and methods consistently obtain the required densities with the equipment on site. If compaction test results are not satisfactory, loose lift thickness will be reduced at the ENGINEER's discretion.
      c. Bring each layer to a moisture content within ± 2 percent of optimum moisture content before compacting.
      d. All lifts of fill materials shall be compacted to 95% of the maximum dry unit weight determined using the ASTM D698 standard method of compaction.

c. Defective compacted embankments: Remove/rework and recompact.
d. In disposal areas: In disposal areas as indicated on the Drawings, bring fill up in an essentially level layer over entire spoil area indicated:
    1) Continue filling spoil area until disposal of surplus excavated material is completed.
    2) Slope edges of fill area at between 1 and 2 horizontal to 1 vertical to the intersection with existing grade.
    3) Provide slopes that are smooth and uniform.
    4) Level finished surface of disposal area to within 4 inches of elevation indicated on the Drawings.
e. Clods or hard lumps of earth of 4 inches in greatest dimension: Break up before compacting material in embankments, except as provided as follows:
    1) When fill material includes large rocky material or hard lumps, such as hardpan or cemented gravel which cannot be broken readily, distribute such material throughout fill.
    2) Place sufficient earth or other fine material around larger material as it is deposited so as to fill interstices and produce dense, compact fill. Do not place such material within 2 feet of finish grade of fill.

3.4 FIELD QUALITY CONTROL

A. Tests:
  1. Confirmation tests:
    a. CONTRACTOR's responsibilities:
        1) Accomplish specified compaction for backfills, fills, and other earthwork.
        2) Control operations by confirmation tests to verify that compaction work complies, and is complying at all times, with requirements specified in this Section concerning compaction, control, and testing.
        3) Cost of confirmation tests: Paid for by the CONTRACTOR.
        4) Qualifications of CONTRACTOR's testing laboratory: Perform confirmation testing by soils testing laboratory acceptable to the ENGINEER.
        5) Copies of confirmation test reports: Submit promptly to the ENGINEER.
    b. Frequency of confirmation testing:
        1) Perform testing not less than the following:
            a) Embankments: 1 test every 500 cy or every other lift, whichever is more frequent.
            b) Pipe Trenches:
                (1) 2 every 500 linear feet
                (2) At each test location include tests for each type or class of backfill from bedding to finish grade.
  2. Compliance tests:
    a. Periodic compliance tests will be made by the ENGINEER to verify that compaction is meeting requirements previously specified.
    b. If compaction fails to meet specified requirements, perform remedial work by one of the following methods:
        1) Remove and replace materials at proper density.
        2) Bring density up to specified level by other means acceptable to the

ENGINEER.

c. Retesting:

1) CONTRACTOR bears the costs of retesting required to confirm and verify that remedial work has brought compaction within specified requirements.

2) CONTRACTOR's confirmation tests during performance of remedial work: Double the normal rate of testing specified.

B. Tolerances:

1. Finish grading of embankments, and fills:

a. Perform fine grading such that finish surfaces are never above the grade or cross section indicated on the Drawings and are never more than 0.10 feet below.

2. Finish grading of surfaces:

a. Reasonably smooth, compacted, and free from irregular surface changes.

b. Provide degree of finish that is ordinarily obtainable from blade grader operations, except as otherwise specified.

c. Finish ditches and gutters so that they drain readily.

3.5 ADJUSTING

A. Finish grades of excavations, backfills, and fills:

1. Repair and reestablish grades to required elevations and slopes due to any settlement or erosion that may occur from action of the elements or any other cause prior to final acceptance.

3.6 PROTECTION

A. Finish grades of backfills, cuts, excavations, and fills:

B. Protect newly graded areas from erosion and deterioration.

END OF SECTION

SECTION 02400

SUBGRADE PREPARATION

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Final subgrade preparation.

B. Certification of subgrade soil.

1.2 RELATED SECTIONS

A. Section 02200 – Site Preparation

B. Section 02300 – Earthwork

C. Section 02714 – Geotextile Fabric

D. Section 02771 – 40-mil HDPE

1.3 PROJECT RECORD DOCUMENTS

A. Submit subgrade certification reports to QA Inspector to countersign prior to covering the area with geosynthetic liner. Liner installation work cannot proceed without written certification reports and approval from QA Inspector.

PART 2 – PRODUCTS

2.1 MATERIALS

A. Only limited offsite soil material will be required for this portion of the project. Portions of the subgrade preparation may require excavation. Suitable excavated materials may be used as compacted fill with ENGINEERS prior approval.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify existing site conditions are in a condition suitable for initiating final grading procedures.

3.2 FINAL GRADING

A. Prepare subgrade soils to receive 40-mil High Density Polyethylene (HDPE) liner by means of grading, rolling and/or track walking.

B. Subgrade will be free from rocks or other sharp objects, mounds, depressions, ridges or any anomaly that may cause concentrated stress or puncture to the HDPE.

3.3 SUBGRADE APPROVAL AND CERTIFICATION

A. CONTRACTOR will certify subgrade prior to material placement.

B. CONTRACTOR (QC Inspector) will provide QA Inspector with daily, written certification of subgrade approval for the QA Inspector's countersignature prior to HDPE placement.

END OF SECTION

SECTION 02714

GEOTEXTILE FABRIC

PART 1 – GENERAL

1.1 SECTION INCLUDES

A. Geotextile fabric

1.2 RELATED SECTIONS

A. Section 02200 – Site Preparation

B. Section 02300 – Earthwork

C. Section 02400 – Subgrade Preparation

D. Section 02771 – 40-mil HDPE

1.3 REFERENCES

A. Latest Version of American Society for Testing and Materials (ASTM) Standards:

B. Latest Version of the Geosynthetic Research Institute (GRI) Standards:

1.4 DEFINITIONS

A. Minimum Average Roll Value (MARV): Property value calculated as typical minus two standard deviations. Statistically, it yields a 97.7 percent degree of confidence that any sample taken during quality assurance testing will exceed value reported.

C. Typical Roll Value: Property value calculated from average or mean obtained from test data.

1.5 SUBMITTALS

A. The CONTRACTOR shall provide the ENGINEER a certificate stating the name of the geotextile manufacturer, product name, style, chemical compositions of filaments or yarns and other pertinent information to fully describe the geotextile. ENGINEER will forward material approval to both the QA and QC personnel.

B. ENGINEER will provide written approval of geotextile prior to ordering material.

C. The Manufacturer is responsible for establishing and maintaining a quality control program to assure compliance with the requirements of the specification.

D. Manufacturing Quality Control (MQC) test results shall be provided upon request.

1.6 DELIVERIES, STORAGE, AND HANDLING

A. Geotextile labeling, shipment and storage shall follow ASTM D 4873. All geotextile shall be stored, handled and installed in accordance with manufacturer's referenced UV exposure time.

C. Product labels shall clearly show the manufacturer or supplier name, style name, and roll number.

D. Each shipping document shall include a notation certifying that the material is in accordance with the manufacturer's certificate.

E. Each geotextile roll shall be wrapped with a material that will protect the geotextile from damage due to shipment, water, sunlight, and contaminants. The protective wrapping shall be maintained during periods of shipment and storage. If the wrapping is damaged prior to installation, the outer wrap of geotextile material must be discarded before installation.

1.7 QUALITY ASSURANCE SAMPLING, TESTING, AND ACCEPTANCE

Geotextile: No testing required.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

A. Huesker

B. Approved Equivalent

2.2 MATERIALS

A. Geotextile (Huesker – Comtrac P45/45 or approved equal)

1. High strength polypropylene woven geotextile with minimum mass per unit area of $7oz/yd^2$.
2. Resistant to ultraviolet degradation and to biological and chemical environments normally found in soils.
3. Minimum Average Roll Values (MARV) as indicated in the following table:

Property	Test Method	Units	Property Requirement
Grab Tensile Strength	ASTM D 4632	lbs	360 x 300
Grab Elongation	ASTM D 4632	Percent	15% x 10%
Puncture Strength	ASTM D 4833	lbs	150
Burst Strength	ASTM D 3786	psi	700
Trapezoidal Tear	ASTM D 4533	lbs	200
Apparent Opening Size (AOS)	ASTM D 4751	US Sieve	30
Permittivity	ASTM D 4491	sec^{-1}	0.4
Water Flow Rate	ASTM D 4491	gpm/ft^2	30
UV Resistance (percent retained at 500 hours)	ASTM D 4355	Percent	80

PART 3 – EXECUTION

3.1 PREPARATION

A. Subgrade should have been smoothed and debris removed prior to geotextile placement.

B. Prepare surfaces to receive geotextile; remove any foreign matter from the subgrade.

3.2 INSTALLATION

A. The geotextile shall be placed in intimate contact with subgrade without wrinkles or folds. The geotextile shall be placed in such a manner that placement of the overlying materials will not excessively stretch so as to tear the geotextile.

B. Sandbags shall be used to hold fabric in place as necessary. Penetrating anchors may be allowed if approved by the ENGINEER.

C. Adjacent rolls of geotextile shall be sewn the full length of the adjacent roll using a "J" stich to form the seam. Prayer seams are not allowed.

D. Overlapped roll ends shall be a minimum of 10 feet in all instances or as directed by the ENGINEER.

E. When overlapping, successive lengths of the geotextile shall be overlapped in the direction of fill placement with subsequent rolls or panels being placed beneath the previous filled panel or roll.

F. Care shall be taken during installation so as to avoid damage occurring to the geotextile as a result of the installation process. Should the geotextile be damaged during installation the material shall be removed and replaced by the CONTRACTOR.

G. Field monitoring shall be performed to verify that fill placement does not damage the geotextile.

H. Any geotextile damaged during backfill placement shall be replaced as directed by the QA Inspector, at the CONTRACTOR's expense.

END OF SECTION

SECTION 02771

40-mil smooth HDPE

PART 1 – GENERAL

1.1 SECTION INCLUDES

A. Furnish and install a 40 mil, high-density polyethylene (HDPE) geomembrane liner (smooth).

1.2 RELATED SECTIONS

A. Section 02200 – Subgrade Preparation

B. Section 02300 – Earthwork

C. Section 02400 – Subgrade Preparation

D. Section 02714 – Geotextile Fabric

1.3 REFERENCES

A. Latest Version of American Society for Testing and Materials (ASTM) Standards:

B. Latest Version of the Geosynthetic Research Institute (GRI) Standards:

1.4 DEFINITIONS

A. Batch: A quantity of resin, usually the capacity of one railcar, used in the fabrication of the geomembrane sheet. The finished sheet will be identified by a roll number corresponding to the particular quantity of resin used.

B. Bridging: The condition when geomembrane becomes suspended over its subgrade due to contraction of the material or poor installation.

C. Construction Quality Control (QC) Personnel: The party, secured by the CONTRACTOR, that is responsible for all of the CONTRACTOR's Construction Quality Control activities related to installation of the geosynthetic components of the lining system.

D. Construction Quality Assurance (QA) Personnel: The site representative of the OWNER responsible for site Quality Assurance documentation.

E. Extrudate: The molten polymer that is emitted from an extruder during seaming using either extrusion fillet or extrusion flat methods. The polymer is initially in the form of a ribbon rod, bead or pellets.

F. Fabricator: The party responsible for the fabrication of geomembrane panels constructed from rolls received from the manufacturer.

G. Geomembrane: An essentially impermeable membrane used as a solid or liquid barrier. In the context of this project it implies a 40-mil high density polyethylene (HDPE) smooth product.

H. Geomembrane Manufacturer: The party responsible for the production of the geomembrane rolls from resin and for the quality of the resin.

I. Liner: An essentially impermeable membrane used as a solid or liquid barrier. Synonymous term for geomembrane.

J. Subgrade: The soil or upon which the geomembrane lies.

K. Installer: The party responsible for field handling, transporting, storing, deploying, seaming, temporary restraining (against wind), and installation of the geomembrane.

L. Panel: The unit area of geomembrane that will be seamed in the field. If the geomembrane is not fabricated into panels in a factory, a panel is identified as a roll or portion of a roll without any seams.

1.5 SUBMITTALS

A. Product Data: Submit the following to ENGINEER for written approval (ENGINEER shall forward approval to both QA and QC personnel) prior to ordering:

1. Resin Data.

    a. Statement of production date or dates.
    b. Product Certifications.
    c. Copy of quality control certificates issued by manufacturer.
    d. Test reports from manufacturer.

2. Geomembrane Roll Data.

    a. Statement of production date or dates.
    b. Laboratory test results and certification stating that the geomembrane meets the product requirements (see Part 2 Products).
    c. Certification stating that all geomembrane rolls are furnished by one supplier, and that all rolls are manufactured from one resin type obtained from one resin supplier.
    d. Copy of quality control certificates issued by manufacturer.
    e. Test reports from the manufacturer.
    f. Typical results of complete notched constant tensile load test (GRI-GM-5) for specified resin and sheet thickness.
    g. Statement certifying that no reclaimed polymer is added to the resin.
    h. Statement listing percentages/total of processing aids, antioxidants, and other additives

other than carbon black added to or in the resin.

i. Geomembrane delivery, storage, and handling instructions.
j. Geomembrane installation instructions.
k. Sample warranties for review.

3. Extrudate Beads and/or Rod.

   a. Statement of production date or dates.
   b. Laboratory certification stating that the extrudate meets the product requirements (see Part 2 - Products).
   c. Certification stating that all extrudate is manufactured by one manufacturer and resin is supplied from one supplier.
   d. Copy of quality control certificates issued by manufacturer.
   e. Test reports from the manufacturer.
   f. Certification stating that the extrudate bead or rod resin is the same type, from the same manufacturer and compatible with the resin used to manufacture the geomembrane supplied for this project.

B. Schedules and Drawings (Installer)

1. Submit installation schedule to OWNER and ENGINEER. Include hours worked per day, week and per shift.

2. Installation layout drawings: Four weeks prior to installation of geomembrane, submit drawings to ENGINEER showing the panel layout indicating both fabricated (if applicable) and field seams, and details not conforming to the Drawings. Upon ENGINEER review, use these drawings for installation of geomembrane.

C. Qualifications (Installer).

1. Submit two weeks prior to installation, name of installer, and resume of installation supervisor/field ENGINEER to be assigned to the project. ENGINEER shall review and approve installers and forward approval to both the QA and QC personnel.

2. Submit, two weeks prior to installation, resume of master seamer.

3. Submit, two weeks prior to installation, resumes of installation seamers performing seaming operations.

D. Field Quality Control Documents (Installer). Follow project Construction QA/QC Plan.

E. Submit upon completion of the installation: (Installer).

1. Certificate stating the liner has been installed in accordance with the Drawings and Specifications.

2. The warranty obtained from the manufacturer/fabricator and the installation warranty.

3. As-built drawings showing location of panels, seams, repairs, patches, and destructive samples, including measurements.

4. Copies of seam test results.

1.6 QUALIFICATIONS

A. Manufacturer/Fabricator/Installation Qualifications: The following are pre-qualified. Substitutions may be considered.

   1. GSE Lining Technology, Inc.

   2. Agru

   3. Polyflex

B. Installer: Must have successfully installed a minimum of 10,000,000 square feet of welded polyethylene geomembrane with documented references.

C. Master Welder Qualifications: Must have completed a minimum of 5,000,000 square feet of polyethylene geomembrane seaming work using the type of seaming apparatus proposed for use on this project.

D. Other Seamers Qualifications: Must have seamed a minimum of 1,000,000 square feet of HDPE geomembrane.

1.7 LABELING, DELIVERY, STORAGE, AND HANDLING (MANUFACTURER)

A. Labeling.

   1. Each roll of geomembrane delivered to the site shall be labeled by the manufacturer. The label shall clearly state the manufacturer's name, product identification, thickness, length, width and roll number.

   2. The label shall be found on either of the end caps, an inside edge of the core, and outside the core.

B. Delivery.

   1. Deliver materials to the site only after ENGINEER accepts required submittals.

   2. Separate damaged rolls from undamaged rolls and store at locations designated by QA Inspector until QA Officer determines proper disposition of the material.

   3. QA Officer will determine damage.

   4. Deliver in rolls, do not fold.

C. Storage on Site: (Installer).

1. Store geomembrane rolls in the space allocated by OWNER.

2. Store geomembrane rolls to protect from puncture, dirt, grease, water, moisture, mud, mechanical abrasions, excessive heat or other damage.

3. Store geomembrane rolls on CONTRACTOR prepared surface (not on wooden pallets).

4. Stack geomembrane no more than four rolls high.

D. Handling on Site: (Installer).

1. Use appropriate handling equipment to load, move, or deploy geomembrane rolls. Appropriate handling equipment includes cloth chokers and spreader bar for loading, spreader, and roll bars for deployment. Dragging panels on ground surface will not be permitted.

2. Do not fold geomembrane material; folded material will be rejected.

3. CONTRACTOR is responsible for off-loading, storage, and transporting material from storage area to installation site.

1.8 QUALITY CONTROL

A. The CONTRACTOR will engage and pay for the services of a party responsible for the continuous testing and documentation of the geomembrane material being installed. Testing will be performed in accordance with both the Construction QA/QC Plan and these Specifications.

1.9 QUALITY ASSURANCE

A. OWNER will engage and pay for the services of independent Construction Quality Assurance (QA) Personnel.

2.0 WARRANTY

A. Provide manufacturer's warranty for geomembrane material in compliance with provisions of the Conditions of the Contract. Provide a minimum 20-year pro rata warranty for the material against deterioration due to exposure to the elements, either exposed or buried. The warranty for material must cover costs of material replacement and installation; assuming the area is rendered in a clean, dry unencumbered condition. In the event the area cannot be rendered as such, compensation for defective material will be provided to OWNER on a pro rata basis for the estimated cost to OWNER at that time of supplying and installing material to a clean, dry, and unencumbered condition by a third party installer.

B. Installation: Provide an installation warranty for geomembrane material in compliance with the conditions of the Contract. Provide a minimum of 2-year non-pro rata warranty for the installation against defects.

PART 2 – PRODUCTS

2.1 GEOMEMBRANE RESIN

A. Meet the following requirements unless otherwise approved:

Test	Test Designation	Requirements
Density (g/cc)[1]	ASTM D-792 Method A or ASTM D-1505	0.94 minimum
[1] Measure on pure resin without additives.		

2.2 GEOMEMBRANE

A. Manufacturing.

1. Do not exceed a combined maximum total of 1 percent by weight of additives other than carbon black or pigment. Identify percentage of processing aids, antioxidants, and other additives other than carbon black.

2. Do not exceed 3.5 percent by weight of finished geomembrane for total combined processing aids, antioxidants, carbon and other additives. Do not exceed 3% carbon black by weight.

3. All additives for UV protection, thermal stability, color, or processing agents must not "bloom" to the surface over time or inhibit welding.

4. Provide finished product free from blemishes, holes, pin holes, bubbles, blisters, excessive gels, undispersed resins, and/or carbon black, contamination by foreign matter and nicks or cuts on edges.

5. Roll manufactured sheets or panel for shipment.

6. Geomembrane may consist of standard black or light reflective white meeting the following requirements unless otherwise approved:

Test	Test Designation	Test Value	Testing Frequency (min.)
Sheet Thickness (min. ave.) • lowest individual for 8/10 values • lowest individual for any of the 10 values	ASTM D 5994	40 mil (-5%) -10% -15%	Per roll
Asperity Height mils (min ave.) *(1)*	ASTM D 7466	-	Every 2nd roll *(2)*
Tensile Properties *(3)* (min. ave.) • yield strength • break strength • yield elongation • break elongation	ASTM D 6693 Type IV	 84 lb/in 152 lb/in 12% 700%	20,000 lb
Tear Resistance	ASTM D 1004	28 lb	45,000 lb
Puncture Resistance	ASTM D 4833	72 lb	45,000 lb
Stress Crack Resistance *(4)*	ASTM D 5397 (Appendix)	300 hr.	Per GRI GM10
Carbon Black Content (range)	ASTM D 4218 *(3)*	2.0-3.0 %	20,000 lb
Carbon Black Dispersion	ASTM D 5596	*note (6).*	45,000 lb
Oxidative Induction Time (OIT) (min ave.) *(5)* (a) standard OIT -or- (b) High Pressure OIT	 ASTM D 3895 ASTM D 5855	 100 min. 400 min	200,000 lb
Oven Aging at 85°C *(7) (8)* (a) standard OIT- (min ave.) %ret after 90 days -or- (b) High Pressure OIT- (min ave.) %ret after 90 days	ASTM D 5721 ASTM D 3895 ASTM D 5855	 55% 80%	Per each Formulation
UV Resistance (9) (a) standard OIT- (min ave.) -or- (b) High Pressure OIT- (min ave.) %ret after 1600 hrs *(11)*	GRI GM 11 ASTM D 3895 ASTM D 5855	 NR *(8)* 50%	Per each formulation

(1) of 10 readings; 8 out of 10 must me ≥7 mils. and lowest individual reading must be ≥ 5 mils; also see note 6.
(2) Alternate the measurement side for double sided textured sheet
(3) Machine direction (MD) and cross machine direction (XMD) average values should be on the basis of 5 test specimens each direction.
Yield elongation is calculated using a gage length of 1.3 inches
Break elongation is calculated using a gage length of 2.0 inches
(4) P-NCTL test is not appropriate for testing geomembranes with textured or irregular rough surfaces. Test should be conducted on smooth edges of textured rolls or on smooth sheets made from the same formulation as being used for the textured sheet materials.
(5) Other methods such as D 1603 (tube furnace) or D 6370 (TGA) are acceptable if an appropriate correlation to D 4218 (muffle furnace) can be established.
(6) Carbon black dispersion (only near spherical agglomerates) for 10 different views: 9 in Categories 1 or 2 and 1 in Category 3
(7) The manufacturer has the option to select either one of the OIT methods listed to evaluate the antioxidant content in the geomembrane.
(8) It is also recommended to evaluate samples at 30 and 60 days to compare with the 90 day response.
(9) The condition of the test should be 20 hr UV cycle at 75°C followed by 4 hr. condensation at 60°C.
(10) Not recommended since the high temperature of the Std-OIT test produces an unrealistic result for some of the antioxidants in the UV exposed samples.
(11) UV resistance is based on percent retained value regardless of the original HP-OIT value

2.3 EXTRUDATE ROD OR BEAD

A. Extrudate rod or bead must:

1. Meet the geomembrane manufacturer requirements.

2. Be made from same resin as the geomembrane.

3. Have thoroughly dispersed additives throughout rod or bead.

4. Contain 2 to 3 percent carbon black content.

5. Be free of contamination by moisture or foreign matter.

2.4 WELDING EQUIPMENT

A. Supplied seam welding accessories must meet the following requirements:

1. Maintain sufficient operational seaming apparatus to continue work without delay.

2. Use power source capable of providing constant voltage under combined line load.

3. Provide protective lining and splash pad large enough to catch spilled fuel under electric generator, if located on liner.

4. Tensiometers capable of measuring seam strength, calibrated and accurate as per applicable ASTM standards.

5. Dies for cutting seam samples.

2.5 MANUFACTURER SOURCE QUALITY CONTROL

A. Provide Manufacturers Quality Control Documentation.

PART 3 – EXECUTION

3.1 EXAMINATION OF GEOMEMBRANE SUBSURFACE

A. Follow procedures set forth in the QA/QC Plan. No geomembrane shall be deployed without written subgrade acceptance.

B. Grade changes rounded to min. 12-inch radius.

C. Subgrade will be free from rocks or other sharp objects, mounds, depressions, ridges or any anomaly that may cause concentrated stress or puncture the geomembrane.

3.2 PREPARATION

A. Repair damage caused to subgrade during deployment.

B. Prepare anchor trenches as shown in Drawings.

C. Perform trial seam welds as follows:

1. Perform trial welds on samples of geomembrane to verify the performance of welding equipment, seaming methods, and conditions.

2. No seaming equipment or welder will be allowed to perform production welds until equipment and welders have successfully completed trial weld.

3. Frequency of trial welds:

    a. Minimum of one trial weld per day prior to the start of work in the morning and one after lunch.
    b. When directed by the QA Personnel.

4. Make trial welds in the same surroundings and environmental conditions as the production welds, i.e., in contact with subgrade.

5. Make trial weld sample at least 2 feet long and 12 inches wide with the seam centered lengthwise.

6. Cut six, one-inch wide test strips from opposite ends of the trial weld.

7. Allow coupons (strips) to cool before testing. Testing should be conducted at 70 degrees (plus or minus 4 degrees) Fahrenheit. Coupons temperatures greater than 70 degrees may result in lowered strengths.

8. Quantitatively test specimens for peel adhesion and bonded seam strength. Peel and shear values shall meet or exceed the following as specified in GRI GM-19:

Geomembrane Nominal Thickness	40 mils
Hot Wedge Seams (1)	
Shear strength (2), lb/in	80
Shear elongation at break (3) %	50
Peel Strength (2), lb/in	60
Peel separation, %	25
Extrusion Fillet Seams	
Shear strength (2), lb/in	80
Shear elongation at break (3) %	50
Peel Strength (2), lb/in	52
Peel separation, %	25

Notes for Table

1. Also for hot air and ultrasonic seaming methods
2. Value listed for shear and peel strengths are for 4 out of 5 specimens, the 5th specimen can be as low as 80% of the listed value
3. Elongation measurements should be omitted for field testing.

9. Repeat the trial weld in its entirety when any of the trial weld samples fail in either peel or shear.

10. When repeated trial weld fails, do not use welding apparatus and welder until deficiencies or conditions are corrected and two consecutive successful trial welds are achieved.

3.3 INSTALLATION

A. Protection

1. Do not use geomembrane surface as work area for preparing patches, storing tools and supplies, or other uses. Use protective cover as work surface, if necessary.

2. Instruct workers about requirements for protection of geomembrane such as handling geomembrane material in high winds, handling equipment, and walking on geomembrane surfaces. Shoes of personnel walking on geomembrane shall be such that they will not damage the liner. Smoking, eating, placing heated equipment directly on geomembrane or other activities that may damage geomembrane is prohibited.

3. Hold a daily meeting to discuss and coordinate work activities as detailed in the QA/QC Plan.

4. Do not operate equipment without spark arresters in vicinity of geomembrane material, or place generators or containers of flammable liquid on geomembrane without the use of a splash pad.

5. Protect geomembrane from vehicular traffic and other hazards.

6. Keep geomembrane clean and free of debris during placement.

B. Geomembrane Deployment.

1. Give careful consideration to the timing and temperature during deployment. The QC Personnel will focus on verifying that (a) there is no bridging or stresses in the geomembrane and (b) there are no wrinkles in the geomembrane that will fold over when covering with soil material. Ideally, deployment, welding, and covering would all occur at the same temperature. In a practical sense, CONTRACTOR should strive to perform these activities within as narrow a temperature range as practical, and avoid these activities during peak hot or cold conditions..

2. Panel Identification: Assign each panel an identifying code number of letter consistent with CONTRACTOR's submitted panel layout drawing. The coding should be coordinated with the QA Personnel.

3. Daily Panel Deployment: Deploy no more panels in one shift than can be welded during that same day.

4. Do not deploy geomembrane during precipitation or moisture events (e.g. fog, drizzle, dew), or during excessive wind.

5. Do not damage geomembrane by handling, trafficking, leakage of hydrocarbons or any other means.

6. Install miscellaneous products required to complete geomembrane installation according to manufacturer's recommendations.

7. Unroll geomembrane panels using methods that will not damage, stretch or crimp geomembrane. Protect underlying surface from damage. CONTRACTOR shall be solely responsible for protection of the subgrade. The QC Personnel will verify that the soils underlying the geomembrane are not damaged.

8. Use methods that minimize wrinkles and differential wrinkles between adjacent panels.

9. Temporarily weight geomembrane sheets with sandbags as necessary to anchor or hold them in position during installation. Use continuous hold-downs along edges to reduce wind flow under sheet.

   a. Sandbag fabric shall be sufficiently close knit to preclude fines from working through bags.
   b. Substitution of sandbags with tires or the use of paper bags even plastic lined paper bags is prohibited. Burlap bags may be used if lined with plastic.
   a. Immediately remove damaged or improperly sealed bags from the work area, and clean up the area affected.

10. Anchor edges of geomembrane as shown in Drawings.

11. Protect geomembrane in area of heavy traffic by placing protective cover that is compatible with and will not damage geomembrane.

12. Repair damage to subgrade or other underlying materials prior to completing deployment of geomembrane.

13. Do not allow vehicular traffic directly on geomembrane, with the exception of a low psi, lightweight vehicle such as a 4-wheel ATV or similar equipment.

14. Remove wrinkled or folded material.

15. Visually inspect geomembrane for imperfections. Mark faulty or suspect areas for repair.

16. Install material to account for shrinkage and contraction while avoiding wrinkles. Install material stress-free with no bridging before it is covered. Add material as needed to avoid bridging.

17. Before wrinkles fold over, attempt to push them out. For wrinkles that cannot be pushed out, cut them out and repair cuts at the direction of the QA Personnel.

C. Geomembrane Seam Layout.

1. Orient seams parallel to line of a maximum slope, i.e., orient down not across slope.

2. Minimize number of field seams in corners, odd-shaped geometric locations and outside corners.

3. Keep horizontal seams (seams running approximately parallel to slope contours) at least 6 feet away from toe or crest of slope.

4. Use seam numbering system compatible with panel number system.

5. Shingle panels on all slopes and grades as indicated in panel layout drawing.

D. Geomembrane Seam Welding Personnel.

1. Provide at least one welder (master welder) who has experience welding over 5 million square feet of geomembrane using the same type of welding apparatus in use at site.

2. Qualify personnel performing welding operations by experience and by successfully passing field-welding tests performed on site.

3. Master welder will provide direct supervision over other welders.

E. Geomembrane Seam Welding Equipment.

1. Extrusion welder: Equipped with gauges showing temperatures in extruder apparatus and at nozzle. Temperature at nozzle may be measured by external temperature gauges.

2. Fusion welder: Automated variable speed vehicular mounted apparatus equipped with devices adjusting and giving temperatures at wedge. Pressure controlled by spring, pneumatic, or other system that allows for variation in sheet thickness. Rigid frame fixed position equipment is not acceptable.

3. Maintain adequate quality of welding apparatus and spare welders in order to avoid delaying the project.

4. Use power source capable of providing constant voltage under combined line load.

5. Keep HDPE feed line clean and free of debris.

F. Geomembrane General Welding Procedures:

1. Do not commence welding with welding equipment until trial weld test sample, made by that equipment, passes test.

2. Clean surface of grease, moisture, dust, dirt, debris, or other foreign material.

3. Overlap panels a minimum 3 inches for extrusion welding.

4. Do not use solvents or adhesives.

5. Extend welding to the outside edge of all panels.

6. If required, provide a firm substrata by using a flat board, conveyor belt, or similar hard surface directly under the weld overlap to achieve firm support.

7. Provide adequate illumination if welding operations are carried out at night.

8. Cut fishmouths or wrinkles along the ridge of the wrinkle in order to achieve a flap overlap. Extrusion weld the cut fishmouths or wrinkles where the overlap is more than 3 inches. When there is less than 3 inches overlap, patch with an oval or round patch extending a minimum of 6 inches beyond the cut in all directions.

9. Weld only when ambient temperature, measured immediately above, but not in contact with the geomembrane, is between 40°F (5°C) and 104°F (40°C).

G. Geomembrane Defects and Repairs.

1. Examine all welds and non-weld areas of the geomembrane for defects, holes, blisters, undispersed raw materials, and any sign of contamination by foreign matter. The surface of the geomembrane shall be clean at the time of the examination.

2. Repair and non-destructively test each suspect location both in weld and non-weld areas. Do not cover geomembrane at locations which have been repaired until test results with passing values are available.

H. Geomembrane Extrusion Type of Welding.

1. Use extrusion welding only for repairs (e.g., patches, caps) and areas not accessible to fusion welding equipment.

2. Purge welding apparatus of heat-degraded extrudate before welding.

3. Bevel top edges of geomembrane a minimum of 45 degrees and full thickness of geomembrane before extrusion welding.

4. Clean seam welding surfaces of oxidation by disc grinder or equivalent not more than 30 minutes before extruding weld. Change grinding discs frequently. Do not use clogged discs.

5. Do not remove more than 4 mils of material when grinding.

6. Grind across, not parallel to, welds.

7. Cover entire width of grind area with extrudate. Abrasion from grinding shall not extend beyond the area extruded.

8. When restarting welding, grind ends of all welds that are more than five minutes old.

I. Geomembrane Hot Wedge Welding.

1. Place smooth insulating plate or fabric beneath hot welding apparatus after usage.

2. Protect against moisture build-up between panels.

3. If welding cross seams, conduct field test welds at least every four hours.

4. Bevel edges of top and bottom panels on cross seams.

5. Do not weld on geomembrane until equipment has passed trial weld test.

6. Extrusion-weld a repair patch over all seam intersections as described in 3.5.

3.4 FIELD QUALITY CONTROL AND QUALITY ASSURANCE

A. General

1. Manufacturer, Fabricator, and Installer will participate in and conform to all terms and requirements of the Construction QA/QC Plan, Drawings, and these Specifications. CONTRACTOR is responsible for assuring this participation. Quality control and quality assurance requirements are as specified in this paragraph and as presented in the Construction QA/QC Plan. If there is a discrepancy in the construction documents, the order of hierarchy shall be 1) Plans, 2) QA/QC manual, and 3) Specifications.

B. Conformance Testing (Performed by QC with separated equipment).

1. Perform conformance testing at the rate of 1 QC test per every 20 QA tests.

C. Field Testing (Performed by Installer).

1. General: Non-destructively test all field seams over their full length using a vacuum test unit, pressure testing, or other approved methods. Perform testing as the seaming progresses and not at the completion of all the field seaming. Complete all required repairs in accordance with this Specification and accepted Industry Standards.

2. Vacuum Testing.

a. Equipment, comprised of the following:

1) A vacuum box assembly consisting of a rigid housing, a transparent viewing window, a soft neoprene gasket attached to the bottom, port hole, or valve assembly, and a vacuum gauge.
2) A vacuum pump assembly equipped with a pressure control.
3) A rubber pressure/vacuum hose with fittings and connections.
4) A soapy solution and an applicator.

b. Test Procedures.

1) Place the box over the area wetted with a soapy solution.
2) Ensure that a leak-tight seal is created.
3) Energize the vacuum pump and reduce the vacuum box pressure to approximately 10 inches of mercury (5 psi, gauge).
4) Examine the geomembrane through the viewing window for the presence of soap bubbles for a period of not less than ten seconds.
5) All areas where soap bubbles appear shall be marked and repaired in accordance with repair procedures described in this specification.

3. Pressure Testing for penetrations or other difficult areas not accessible for vacuum testing.

a. Equipment and Materials.

1) Bicycle-type pump.
2) Football-type needle for pumping.
3) Pressure gauge.

b. Procedures.

1) Place needle into channel between welds, sealing off the other end of a seam. Pump pressure within seam to 30 psi and hold, recording pressure on pressure gauge.
2) Hold pressure for at least 5 minutes. As long as the pressure does not drop more than 3 psi, the seam passes.
3) Before releasing pressure, cut the blockage at the far end of the seam tested. If the pressure releases, the seam can be accepted. If the pressure does not release, there is intermediate blockage and iterative testing is required to verify the actual length of seam tested.

4. Destructive Testing (performed by Installer).

a. Location and Frequency of Testing.

1) Collect destructive test samples at a minimum frequency of one test location per average **500** feet of seam length.
2) Determine test locations during welding. Locations may be prompted by suspicion or excess crystallinity, contamination, offset welds, or suspected defect. QC Inspector will be responsible for choosing the locations.
3) The QA Inspector may increase the test frequency based on marginal results.

b. Sampling Procedures.

1) Cut samples at locations designated by the QC Inspector as the welding progresses. Verify that destructive test results have been obtained before the geomembrane is covered by another material.
2) QC Inspector will number each sample and mark sample number and location in compliance with the Construction QA/QC Plan.

c. Immediately repair all holes in the geomembrane resulting from destructive test sampling. Repair in accordance with repair procedures described in this Section. Test the continuity of the repair in accordance with this Section.

d. Size of Sample: minimum 12 inches wide by 36 inches long with the seam centered lengthwise. Cut a one-inch wide strip from each end of the sample and test these for (shear and peel) in the field. Cut the remaining sample into three parts for distribution as follows:

1) One portion for Installer: 12 inches by 12 inches.
2) Two portions to QA Inspector for archive storage and testing: minimum 12 inches by 12 inches.

e. Field Testing (Performed by Installer)

1) Test the two, one-inch wide strips specified in paragraph d above by tensiometer for peel and shear, respectively.
2) Both test strips must meet peel and shear requirements for welded seams specified in this Section.
3) If any field test sample fails, follow failed test procedures outlined in this Section.

D. Failed Weld Procedures.

1. Follow these procedures when there is a destructive test failure. Procedures apply when test failure is determined by the QC Inspector or QA Inspector, or by field tensiometer. Follow one of the following two options:

a. First Option.

1) Reconstruct the seam between any two passing test locations. (Cannot extrusion weld flap.)

b. Second Option.

1) Trace the weld at least 10 feet minimum in both directions from the location of the failed test, or to the end of the weld.
2) Obtain a small sample at both locations for additional peal and shear tests.

3) Perform additional peal and shear tests.
4) If the additional peal and shear tests pass, then reconstruct the weld or cap between the two test sample locations that bracket the failed test location.
5) If any sample fails, then repeat the process to establish the zone in which the weld must be reconstructed.

E. Acceptable Welded Seams.

1. Bracketed by two locations from which samples have passed additional peal and shear tests.

2. For reconstructed seams exceeding 50 feet, a sample taken from within the reconstructed weld passes destructive testing.

F. Seams That Cannot Be Non-Destructively Tested: Perform the following:

1. If the weld is accessible to testing equipment prior to final installation, non-destructively test the weld prior to final installation.

2. If the weld cannot be tested prior to final installation, cap strip the weld. The welding and cap-stripping operations must be observed by the QC and QA Personnel for uniformity and completeness.

3.5 REPAIR PROCEDURES

A. Remove damaged geomembrane and replace with acceptable geomembrane materials if damage cannot be satisfactorily repaired.

B. Repair, removal, and replacement is at CONTRACTOR's expense if the damage results from CONTRACTOR's or Installer's activities or material defects.

C. Repair any portion of the geomembrane exhibiting a flaw, or failing a destructive or non-destructive test. Do not commence welding on liner until trial weld test sample passes trial test. Repair procedures available include:

1. Patching: Used to repair large holes (over 3/8-inch diameter), tears, pinholes or other minor, localized flaws.

2. Abrading: Used to repair small sections of seams.

3. Spot welding or seaming: Used to repair small tears (less than 2 inches long), pinholes or other minor, localized flaws.

4. Capping: Used to repair large lengths of failed seams.

5. Removing the seam and replacing with a strip of new material.

D. In addition, satisfy the following procedures:

1. Abrade geomembrane surfaces to be repaired (extrusion welds only) no more than one-half (1/2) hour prior to the repair.

2. Clean and dry all surfaces at the time of repair.

3. Extend patches or caps at least 6 inches beyond the edge of the defect, and round all corners of material to be patched and the patches to a radius of at least 3 inches.

E. Verification of repair:

1. Number and log each patch repair.

2. Non-destructively test each repair using methods specified in this Section.

3. Additional destructive tests may be required at the discretion of QA Personnel.

4. Reconstruct repairs until tests indicate passing results.

3.6 CLEANUP

A. Clean up work area as work proceeds. Take particular care to ensure that no trash, tools, or other unwanted materials are trapped beneath the geomembrane and that scraps of geomembrane material are removed from the work area prior to completion of the installation.

3.7 GEOMEMBRANE ACCEPTANCE

A. CONTRACTOR retains all ownership and responsibility for the geomembrane until acceptance by Owner.

B. Owner will accept geomembrane installation when:

1. All required documentation from the Manufacturer, Fabricator (if applicable), and Installer has been received and accepted.

2. The geomembrane installation is finished.

3. Test reports verifying completion of all field seams and repairs, including associated testing, is in accord with the Section.

4. Written certification documents and drawings have been received by OWNER.

END OF SECTION

APPENDIX G

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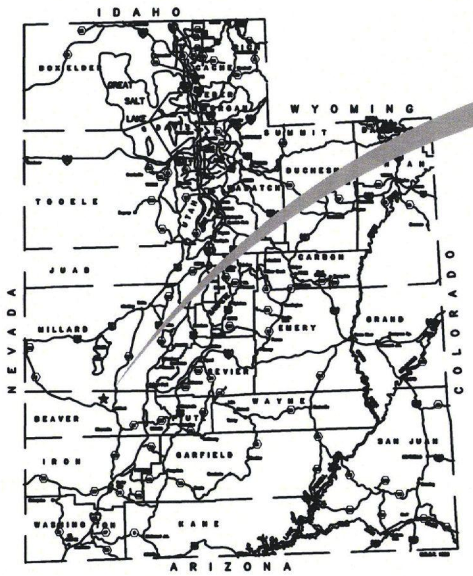
INTERMEDIATE TAILINGS DISPOSAL FACILITY

LIST OF DRAWINGS



SITE LOCATION

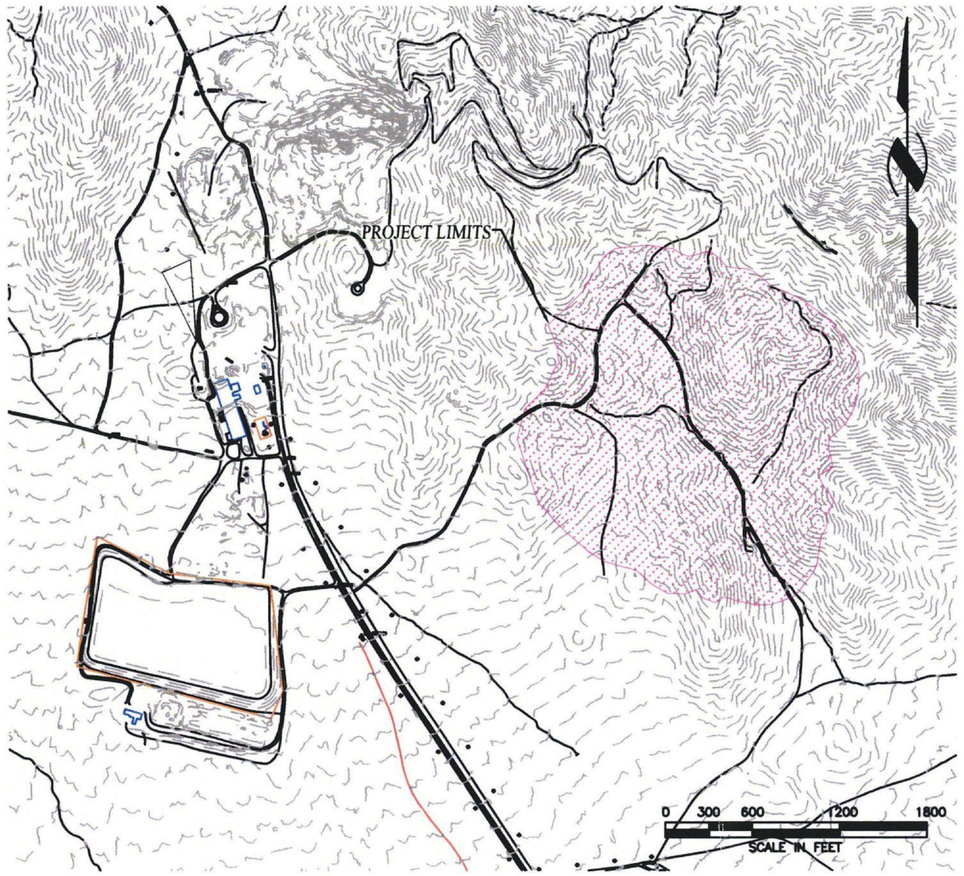
LAT: 38.4807°N
LONG: -113.1175°W

UTM NAD 27
EASTING (m): 315296.96
NORTHING (m): 4261079.37

COUNTY: BEAVER

PLS LOCATION
NWNW SECTION 8
T27S R 11 W, SLB&M

SITE VICINITY



SITE MAP

REFERENCE:
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157987
STATE OF UTAH

MARK	DATE	DESCRIPTION
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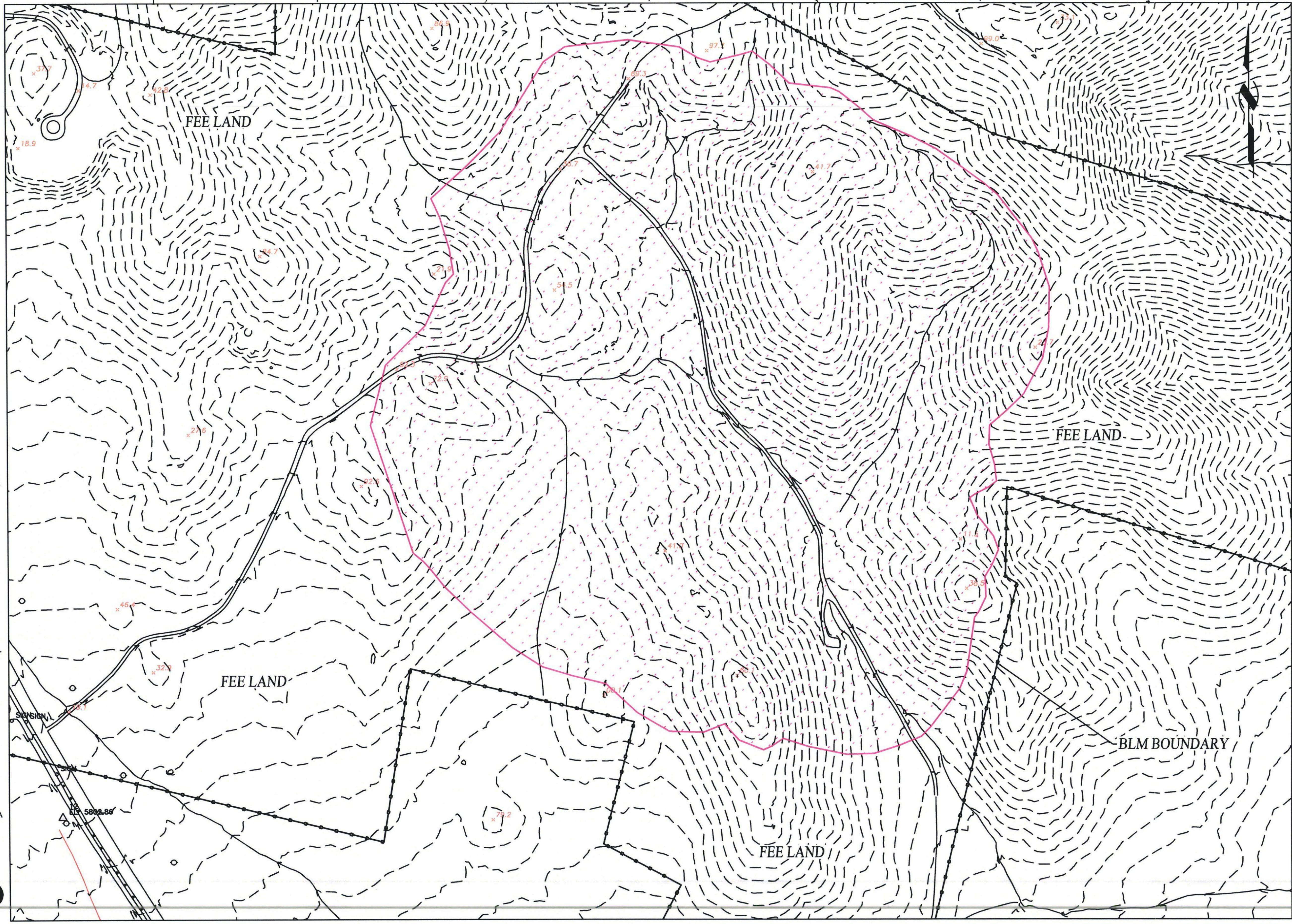
SHEET TITLE

CS MINING-TAILINGS STORAGE

TITLE SHEET

1



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0 75 150 300 450
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BLM BOUNDARY (APPROX)
EXISTING CONTOUR (10')
APPROXIMATE LIMITS OF DISTURBANCE

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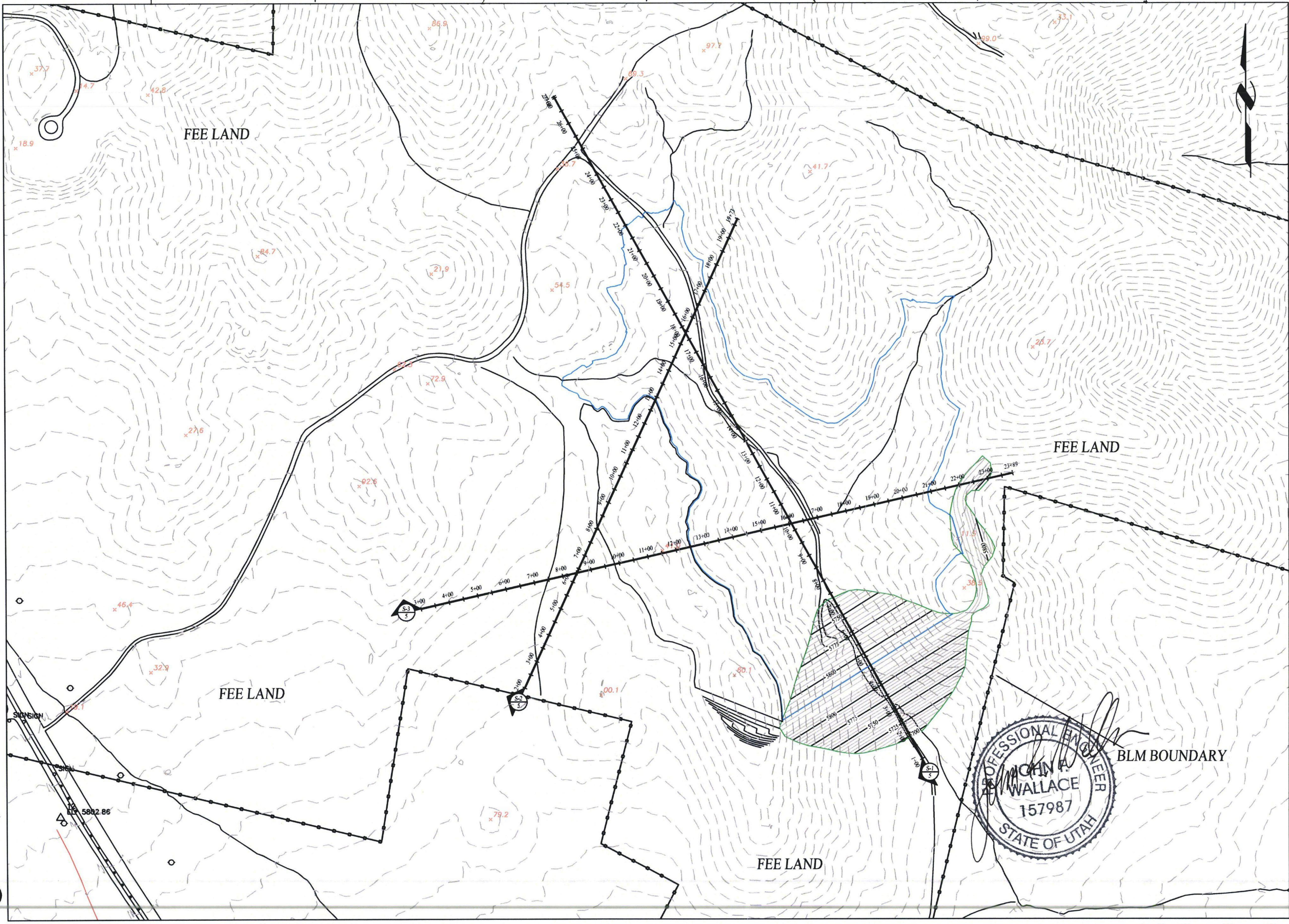
SITE PLAN

2



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— BLM BOUNDARY (APPROX)
— EXISTING CONTOUR (10')
— LIMITS OF TAILINGS/WATER (ELEV: 5814')

NOTES:

EAST STARTER & SADDLE
ELEV. 5820':
CUT/FILL - 415,000 CYD
WATER/TAILINGS CAPACITY:
(FILL TO 5814') -1,118,600 CYD*
LINED AREA - 1,300,000 SQ-FT

*DOES NOT INCLUDE ADDITIONAL AIRSPACE FOR BORROW OBTAINED WITHIN IMPOUNDMENT

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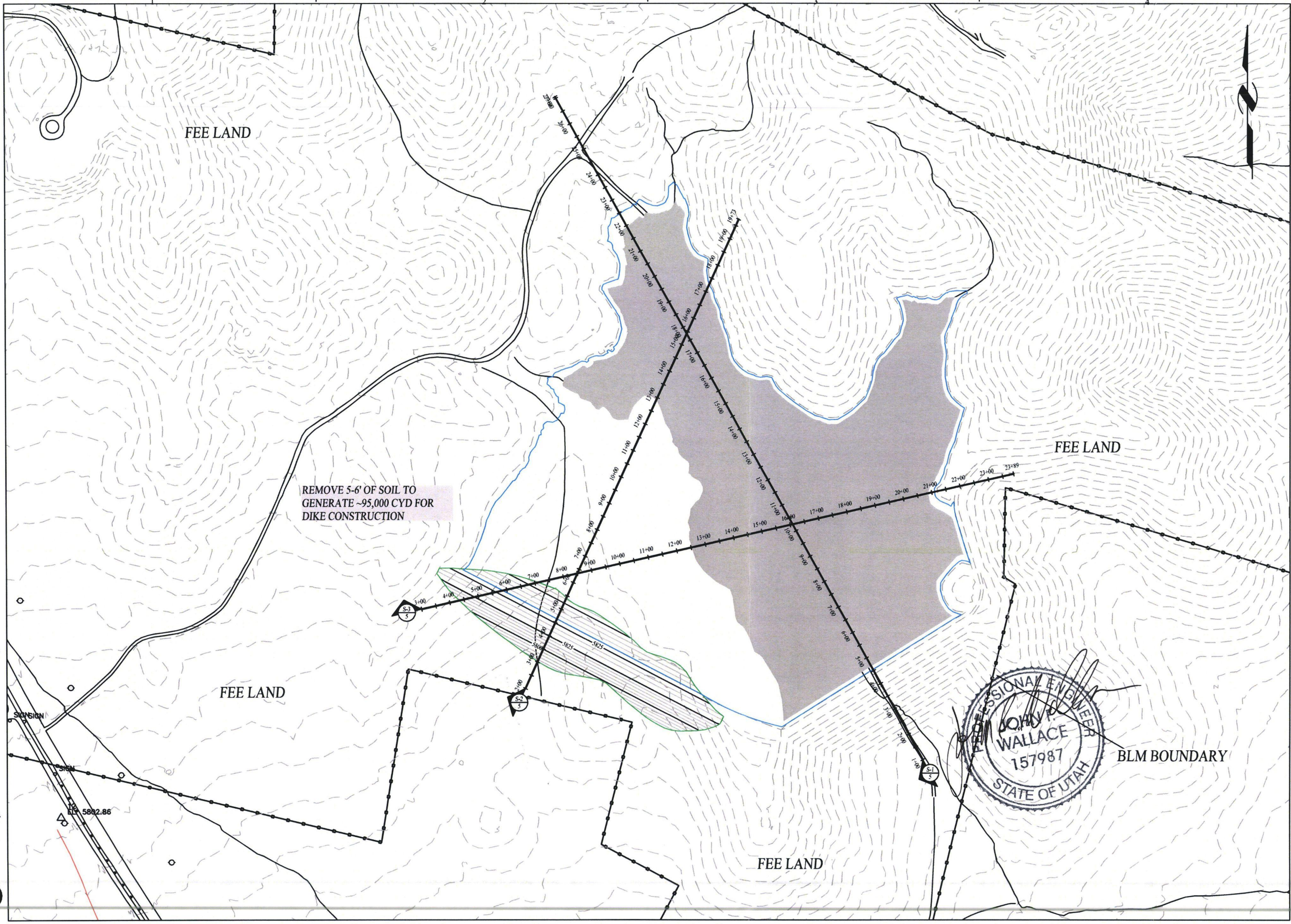
EAST POND STARTER DAM



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BLM BOUNDARY (APPROX)
EXISTING CONTOUR (10')
LIMITS OF TAILINGS/WATER (ELEV: 5818')
EXTENT OF EAST STARTER DAM INITIAL STORAGE (ELEV: 5814')

NOTES:

WEST STARTER DIKE ELEV. 5830':
CUT/FILL - 151,000 CYD
WATER/TAILINGS CAPACITY:
(FILL TO 5818') - 465,600 CYD*
CUMULATIVE CAPACITY:
1,584,200 CYD

* INCLUDES BORROW AIRSPACE FROM WITHIN WEST IMPOUNDMENT

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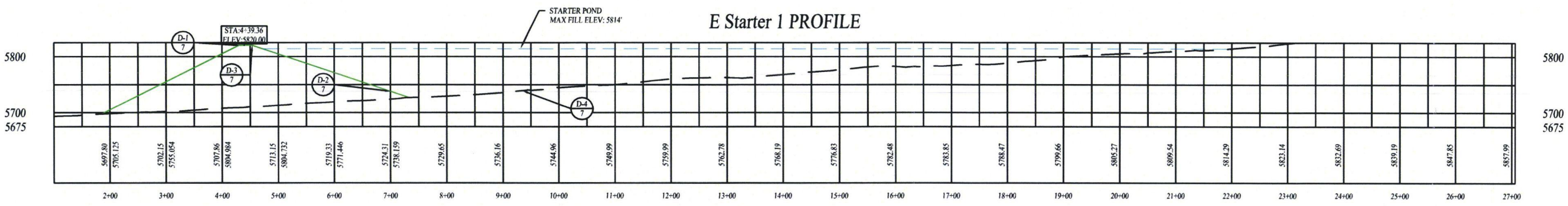
WEST POND STARTER DIKE

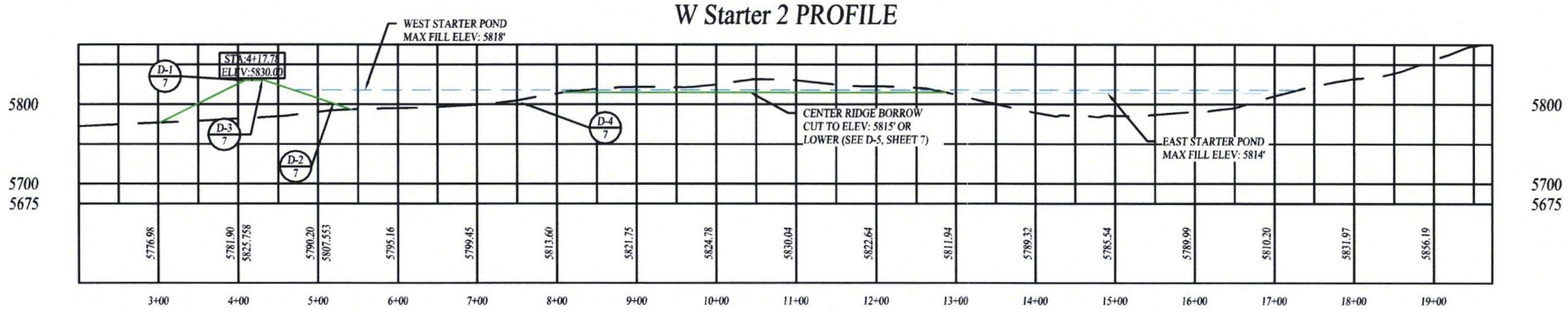
4

E Starter 1 PROFILE



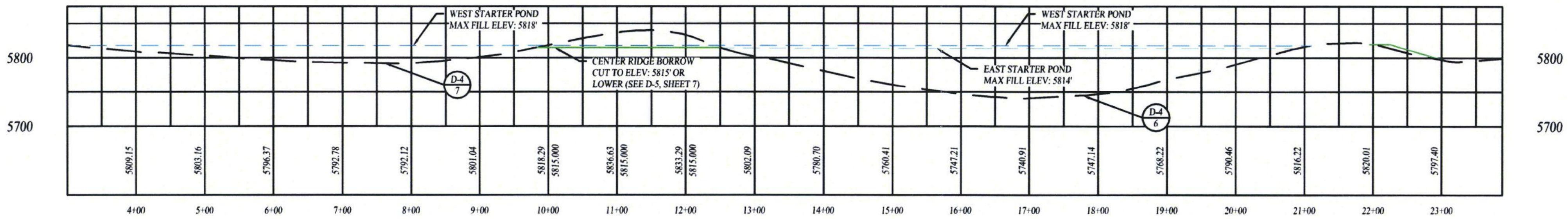
SECTION 1 - EAST STARTER DAM
1" = 100'
S-1
3,4

W Starter 2 PROFILE



SECTION 2 - WEST STARTER DAM
1" = 100'
S-2
3,4

Starter Combined PROFILE



SECTION 3 - COMBINED PONDS
1" = 100'
S-3
3,4

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0 50 100 200 300
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----- EXISTING GROUND
PROPOSED GRADE
TAILINGS/WATER FILL

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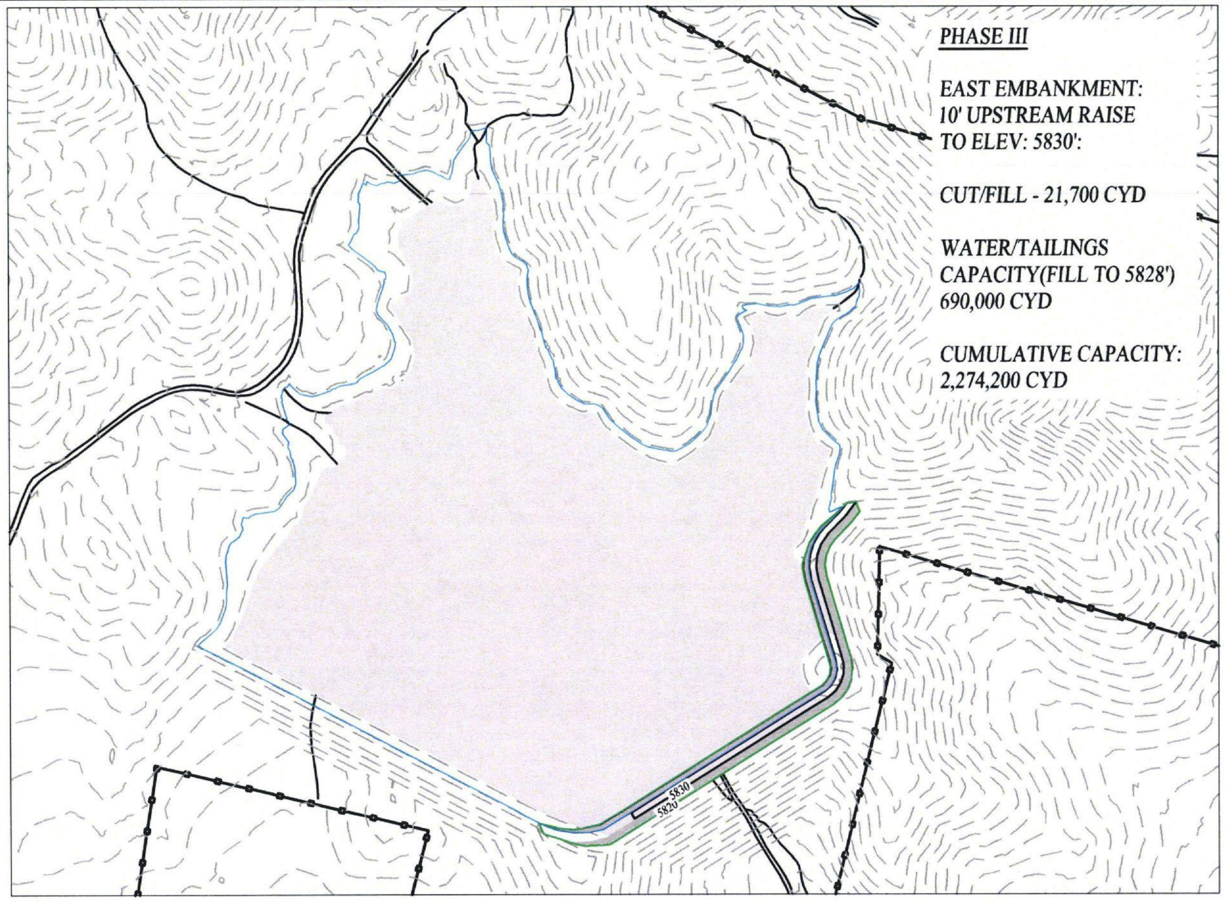
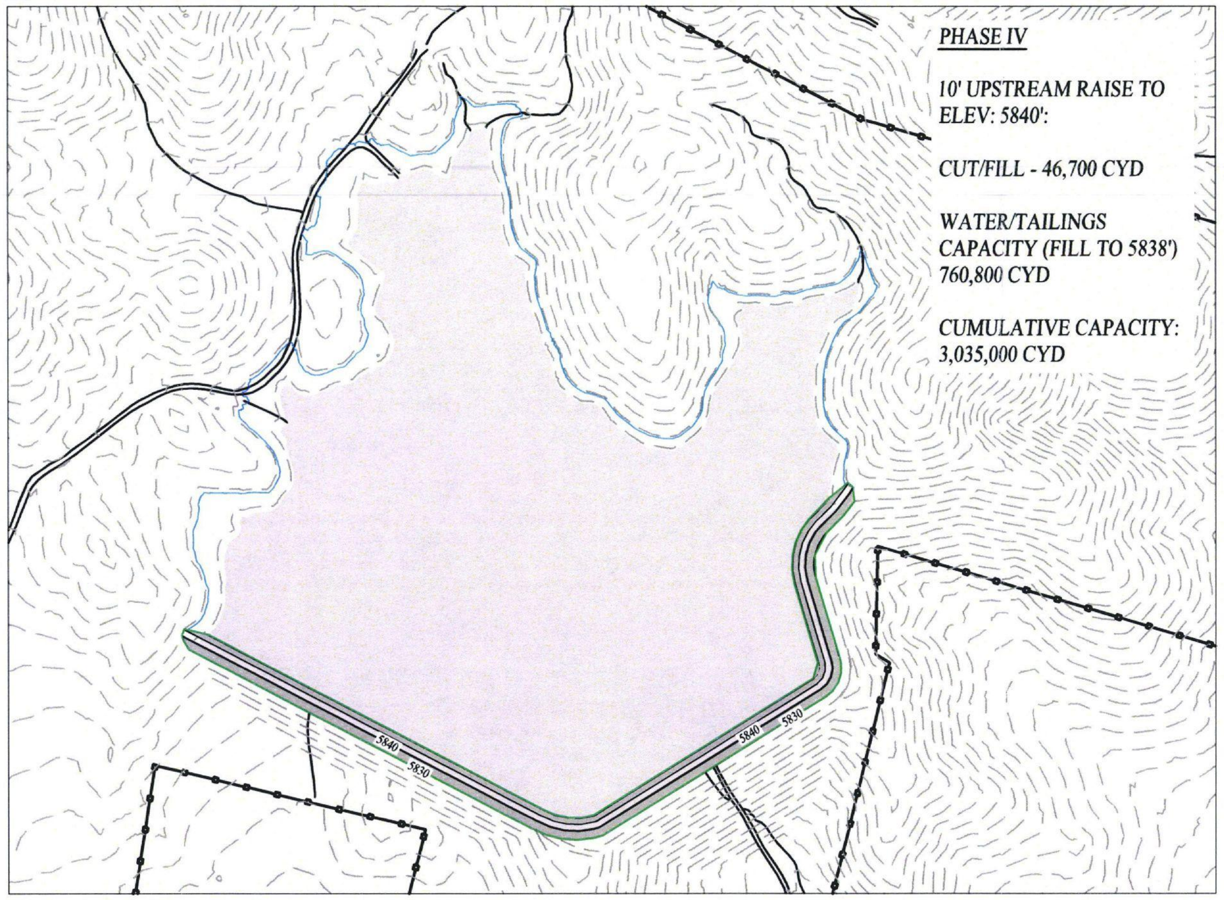
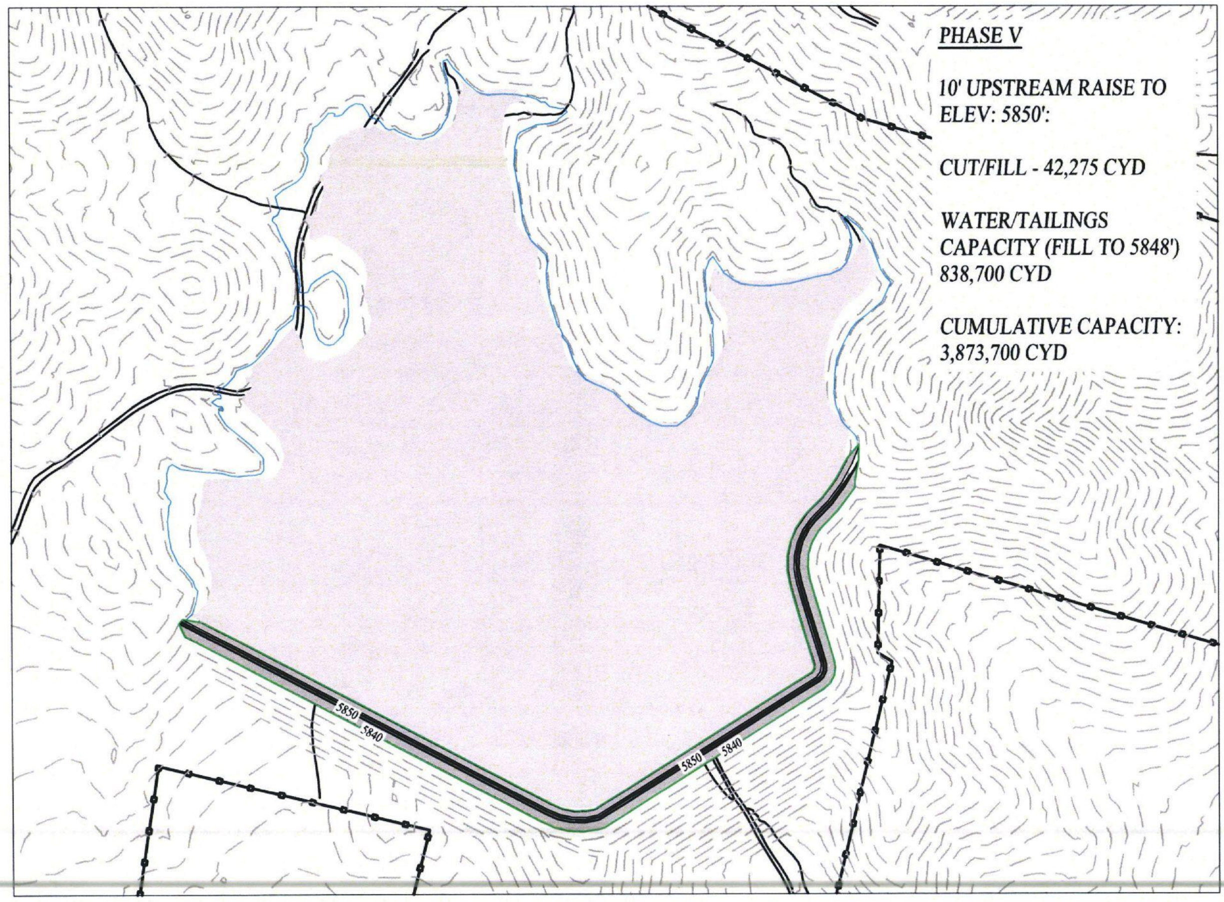
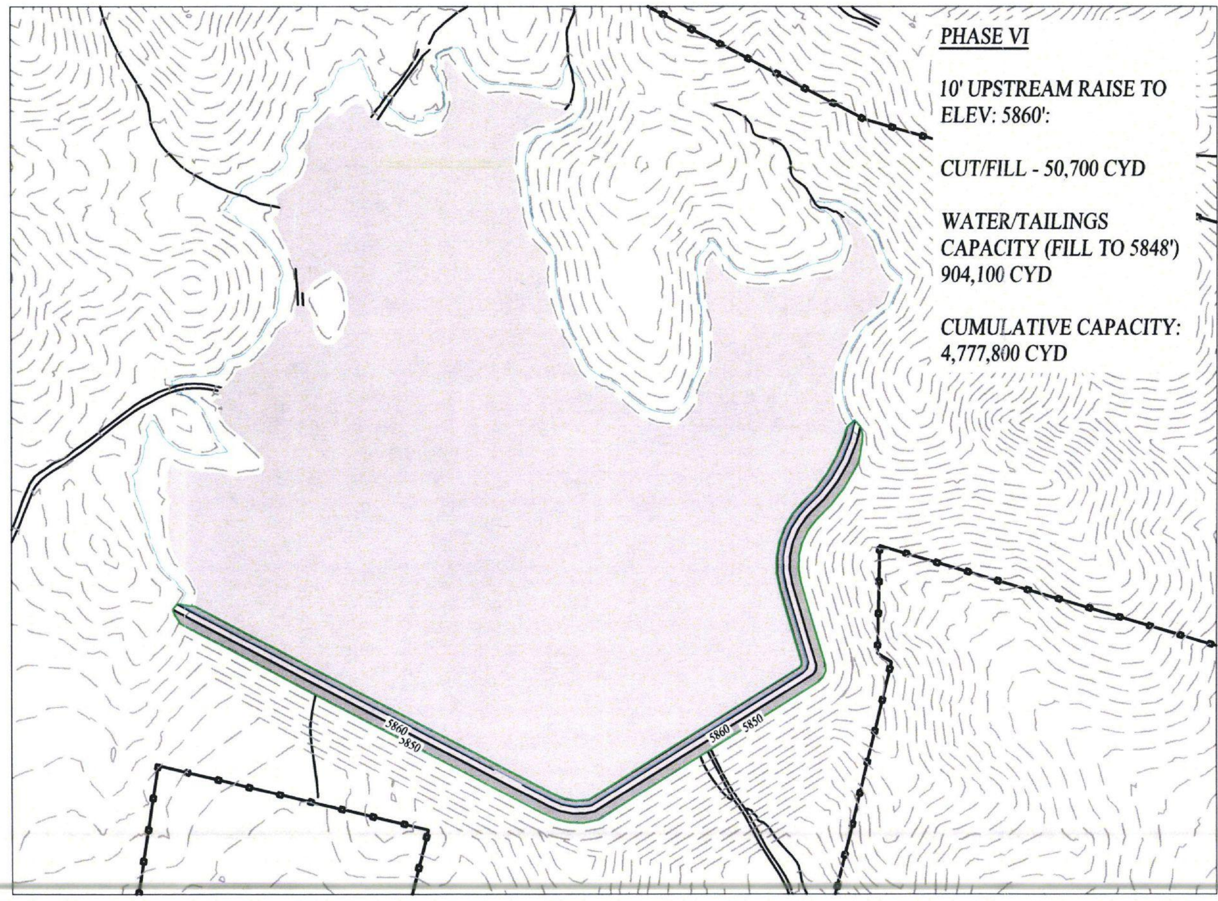
ELEVATION VIEW

5









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0 125 250 500 750
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- BLM BOUNDARY (APPROX)
- EXISTING CONTOUR (10')
- LIMITS OF TAILINGS/WATER
- PREVIOUS TAILINGS FILL

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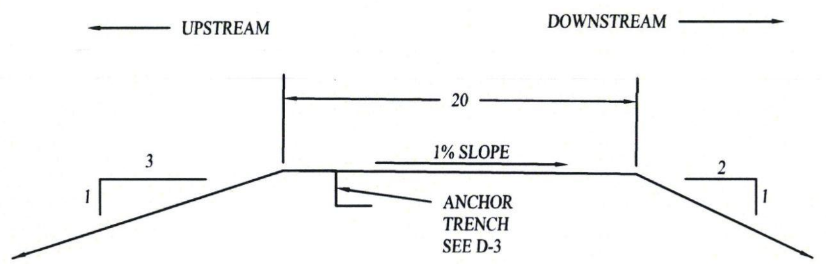
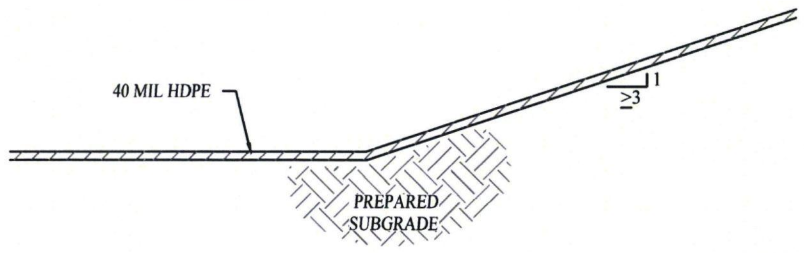
PHASES III - VI UPSTREAM RAISES

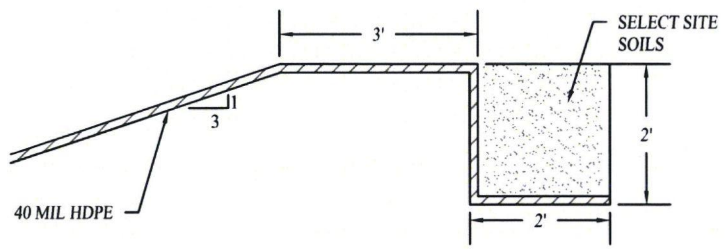
6



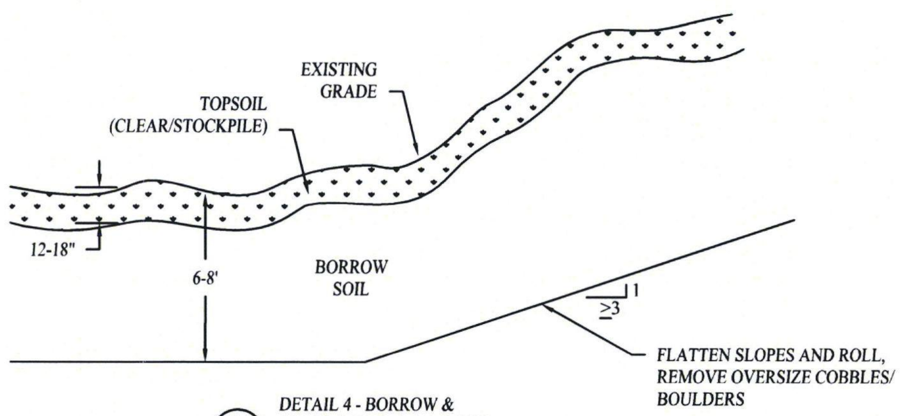
D-1 / 5 DETAIL 1 - STARTER DAM CREST & FILL SLOPES
NTS



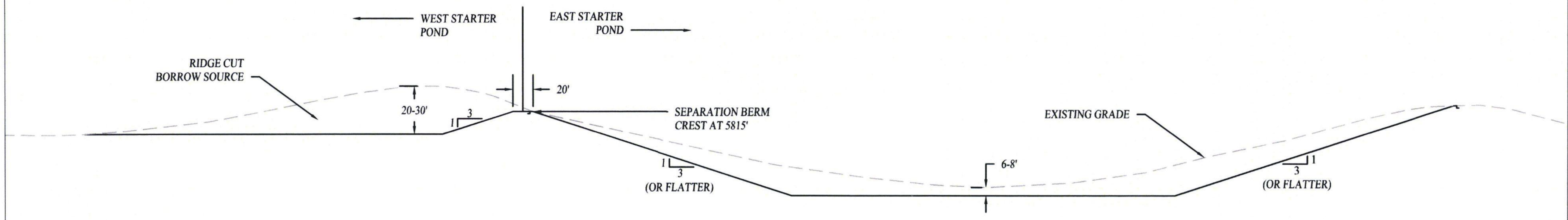
D-2 / 5 DETAIL 2 - HDPE INSTALLATION
NTS



D-3 / 5 DETAIL 3 - HDPE ANCHOR
NTS



D-4 / 5 DETAIL 4 - BORROW & SUBGRADE PREPARATION
NTS



D-5 / 5 DETAIL 5 - TYPICAL BORROW GENERATION
NTS

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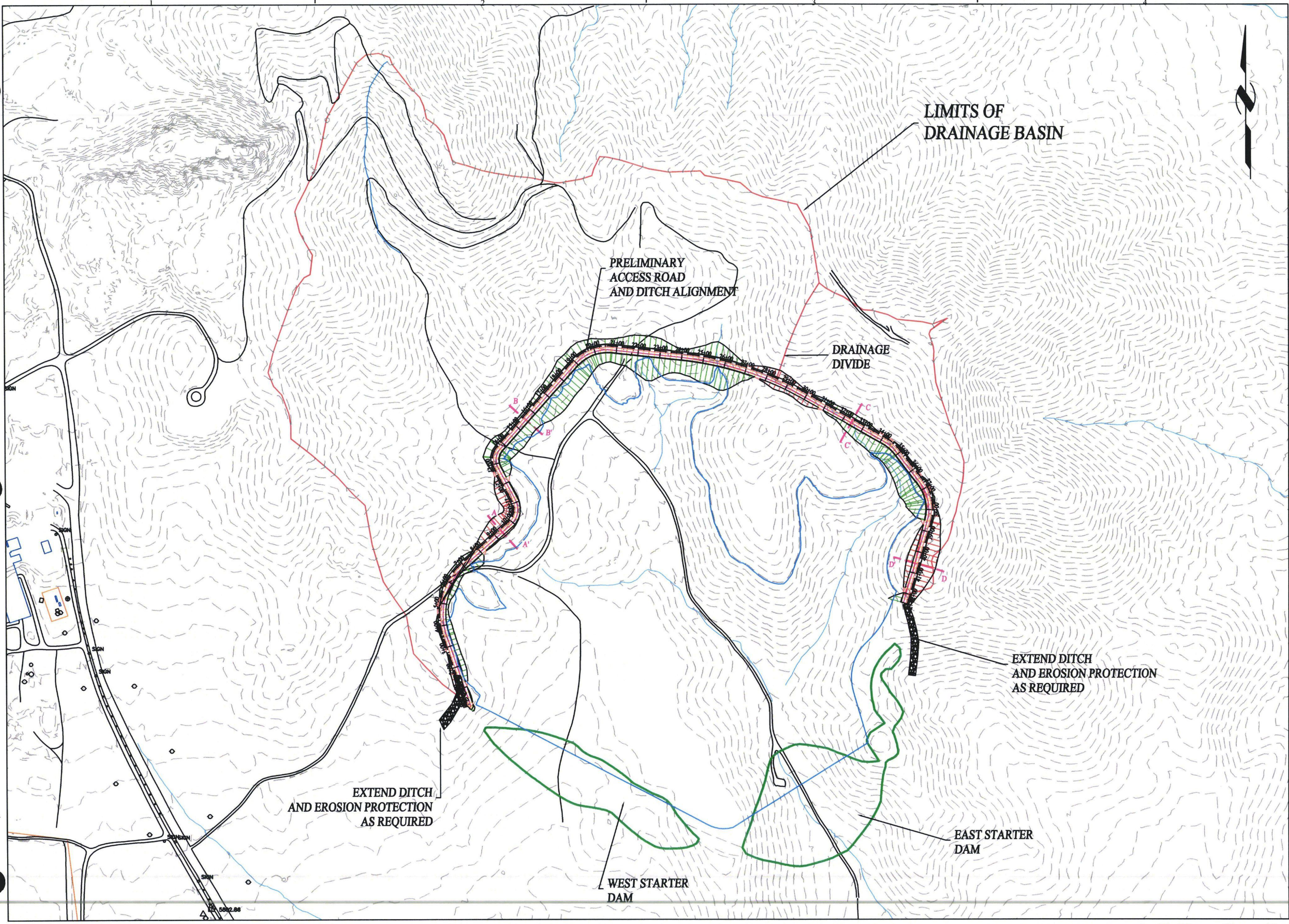
DETAILS



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0 100 200 400 600
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- EXISTING CONTOUR (10')
- LIMITS OF DRAINAGE
- LIMITS OF TAILINGS/WATER (ELEV 5858')
- LIMITS OF EAST AND WEST STARTER DAM FILL

NOTES:

APPROXIMATE ROAD AND DITCH ALIGNMENT TO BE FIELD ADJUSTED

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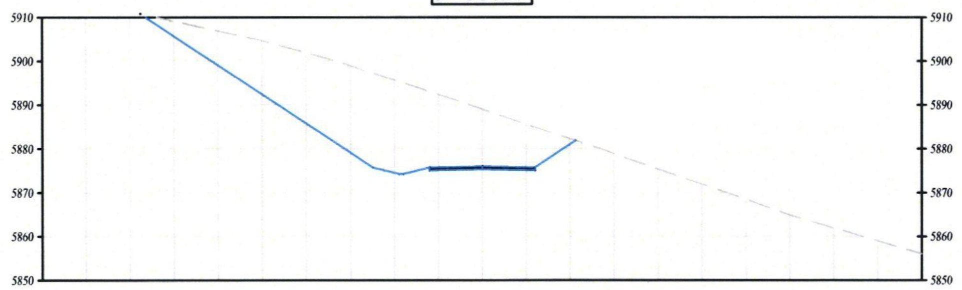
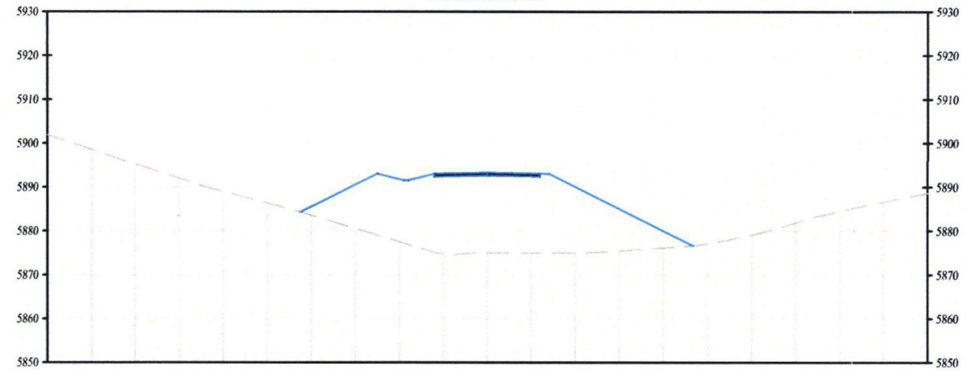
ROAD AND DITCH ALIGNMENT

9+35.36



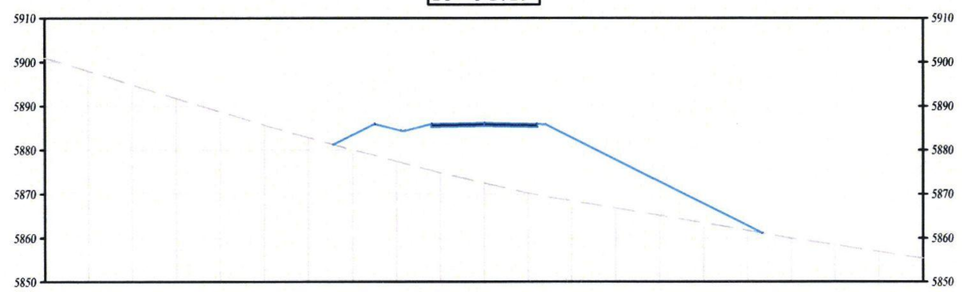
SECTION A-A'

32+40.58



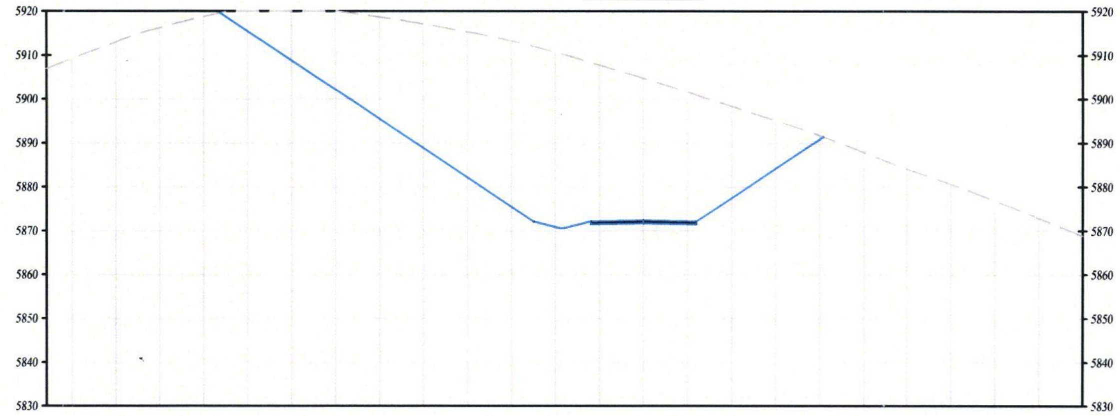
SECTION B-B'

15+51.19



SECTION C-C'

40+54.44



SECTION D-D'

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— — — EXISTING GRADE
——— PROPOSED GRADE

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ROAD AND DITCH CROSS SECTIONS